ATMOSPHERIC ISSUES & SERVICES BRANCH

REPORT

Pacific & Yukon Region

Lower Fraser Valley Oxidants Study
Pacific 93 - Meta Data Report

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Atmospheric Environment Service
Pacific & Yukon Region

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Report PAES-93-9

Lower Fraser Valley Oxidants Study

& Pacific 93

Meta Data Report

Data Measurement Program

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The Lower Fraser Valley Oxidant Study
Meta Data Report for PACIFIC 93

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1. Introduction:

The formation of photochemical SMOG in the Lower Fraser Valley (LFV) has been a topic of interest within the research community near the British Columbia/Washington border for several years. A research effort is under way at the University of British Columbia (UBC) to model meteorological and photochemical processes in the LFV during ground level ozone episodes. Similar interests have developed within Environment Canada and with the Institute for Environmental Chemistry, National Research Council Canada (NRC). These activities fall under the umbrella of a five year Canadian oxidant research plan prepared by the Canadian Institute for Research in Atmospheric Chemistry (CIRAC).

Activities in this study are centered around the development of a modelling system to describe the meteorology and photochemistry associated with production of elevated ground level ozone concentrations within the LFV. A comprehensive data set is needed to initialize and validate the modelling system. This report describes the development and execution of an intensive field study to provide these data.

2. Field Study - PACIFIC 93:

The climatology of elevated ground level ozone concentrations indicated that the best window for the study would be the last two weeks of July and the first two weeks of August. Study dates were July 15th to August 12th. Many partnerships were developed in order to complete all of the necessary measurement programs. The partners included CIRAC, Environment Canada, University of British Columbia, the National Research Council, B.C. Ministry of Environment, Lands and Parks, Greater Vancouver Regional District, York University, U.S. National Oceanographic and Atmospheric Administration, Unisearch, University of Victoria, Conservation and Protection, Desert Research Institute, and Western Washington University. Using the available historical data and the above mentioned field study strategy, the field sites were located as shown in Figure 1.

2.1 Measurement Program:

The fast chemistry site was located at the north end of Harris Road and is depicted in detail in Figure 2. This site was the main surface chemistry site with the most comprehensive measurement program (see Table I). Data were collected 24 hours a day for the entire study period. Measurements were continuous in most cases with analyses completed on site for many of the chemicals. Exception were the VOC canister samples where 4 grab samples were take per day with one being a replicate. The Differential Optical Absorption Sprectroscopy (DOAS) instrument operated during the night and was interrupted only by the formation of mist and the occurrence of precipitation. Particulates were measured continuously using a Particle Mass Selective Sampler

(PMS) and an Active Spectrometer Aerosol Sampling Probe (ASASP). Particle light scattering b_{scat} was determined with an Optec nephelometer.

A second measurement program was operated at the mature chemistry site located at CFS Aldergrove (see Figure 3). Measurements made at the Aldergrove site are summarized in Table I. Most of the measurements were continuous for the duration of the study. Exceptions were the $RONO_2$ and the VOC grab samples.

Profiles of O_3 and NO_2 as well as wind, temperature and humidity were measured with a tethersonde program at the Harris Road site. A similar package acquired O_3 and meteorological data further north over Pitt Lake. The tethersonde program operated daily through the period of elevated ozone.

The Harris Road and Aldergrove sites each had a full meteorological station measuring wind speed and direction, temperature and humidity. Rainfall measuring instruments were in place at the Harris Road site. Three dimensional wind patterns of the LFV and several side valleys were measured over a 30 km radius with a doppler LIDAR situated at the Pitt Meadows Airport, located 5 km south of the Harris Road site. The LIDAR performed both horizontal (RHI) and vertical (CAPPI) scans to provide a three dimensional analysis of the winds at micro to mesoscales.

Meteorological and ozone releases were performed in Langley (T27 on Figure 1, details in Figure 4). During the earlier part of the study, meteorological sondes were released twice daily. A single ozonesonde was released during this period to acquire an ozone profile for a "clean" day. When the weather conditions became hot and sunny on July 31st, the program increased to 5 releases per day and included both meteorological and ozonesondes. The releases were at 4 am, 10 am, 1 pm, 4 pm and 7 pm PST (Pacific Standard Time). This program concluded on August 6th as the period of hot weather ended.

An aircraft program was developed to investigate the entire valley. A downward looking LIDAR measured light scattering or aerosol loading from which mixed layer depth can be inferred. The complete list of chemistry and aerosol instrumentation on the aircraft is given in Table II. The flights began on July 19th and included aerial coverage of the east coast of Vancouver Island and eastward across the LFV as far as Hope, B.C. and as far south as Bellingham in Washington. To accommodate the LIDAR operation, flights were flown at just above 4000 metres with lower flights at 500 metres for the boundary layer chemistry and aerosol measurements (see Figure 5). Aerosol and chemistry data were taken during the 4000 m flights as well. From July 19th to August 10th, 16 flights were completed using over 65 hours of aircraft time. A full report on the data gathered from the aircraft program is reported in another publication (contact is Walter Strapp).

3. Other Related Studies:

Prior to Pacific 93, flux studies of biogenic VOCs from an indigenous forest canopy were completed at a site on Vancouver Island. These measurements were taken to determine the contribution of biogenic VOC emissions to the overall inventory. This study will provide information from forest canopies characteristic of this region of B.C.

Except for the aircraft program, all of the measurements mentioned have been on the Canadian side of the LFV. Through the cooperation of the Northwest Air Pollution Control

Association and Western Washington University, O_3, NO_x and meteorological parameters were measured at a number of locations in Whatcom County, Wash.

The BC MoELP undertook an extensive visibility measurement study, REVEAL, through the same time period as Pacific 93. An Interagency Monitoring of Protected Visual Environments (IMPROVE) sampler was located at the Harris Road site. Other IMPROVE samplers, as well as a transmissometer and a nephelometer, were sited in the eastern portion of the Valley, on Vancouver Island and at the University of British.

In the Canadian portion of the Valley, impacts of ground level ozone on health and vegetation were being monitored during the field study. A program to measure sensible and latent heat fluxes, radiation and UV flux density was also carried out in the Valley.

4. Data Records:

Tremendous quantities of data were generated through the many measurement programs active during the field study. The first report from Pacific 93 is the meta data report which describes the data sites and measurement schedules. The data sets will be available to principal investigators by the end of January 1994 with a data reporting workshop planned for early April.

The first part of this meta data report includes schematics of the three principal sites at Harris Road, CFS Aldergrove, and Langley. This is immediately followed by a contact list of principal investigators. The tables titled "Surface Measurement Program" list measurement activities at these sites followed by measurements of related studies taken elsewhere. The "Aircraft Measurement Program" lists all airborne measurements and instruments used, excluding flight dates. A "Daily Log" follows, which is a record of the dates and times of aircraft flights, tethersonde releases, ozone and met sonde releases, and of Doppler Lidar, DOAS, and nephelometer operations. The remainder of the report consists of a meteorology log and some climatological data for the months of July and August.

Table I: Measurements and Instruments

Harris Road (fast chemistry) Site

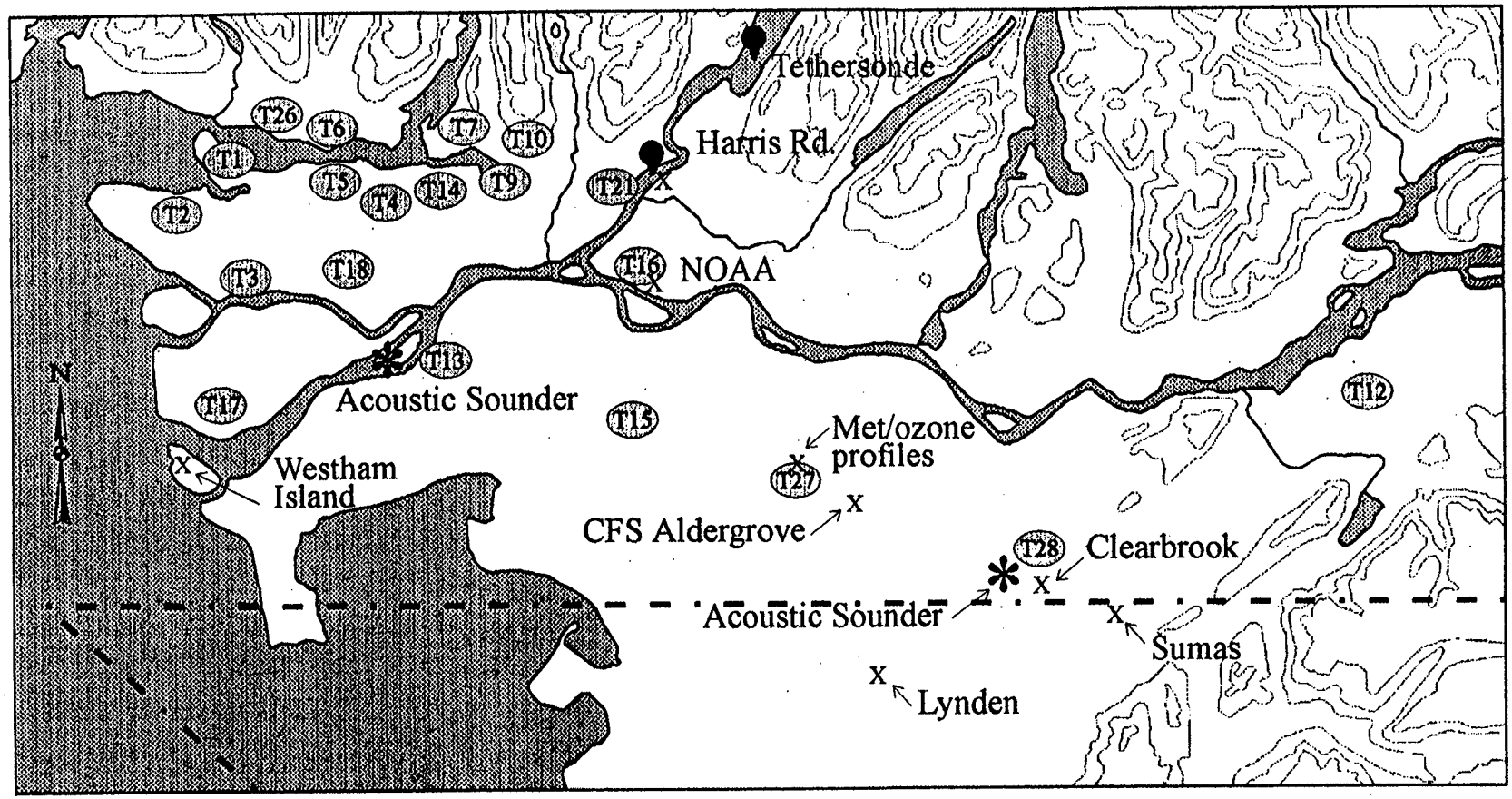
Measurement	Instrument
O_3	TECO 49
NO/NO_2	Ecophysics
$HNO_3/NO_3^-/NH_3$	filterpack
NO/NOy	Monitor Labs 8440 modified
SO_2	TECO 43S
RO_2H	HPLC
H_2O_2	Kok
NO_2 actinometer	Monitor Labs
CO	TECO 48
PAN	GC/ECD
VOCs	Chrompack
$RONO_2$	Cartridge
HONO	denuder
$HONO/NO_3^-/CH_2O$	TDL
particle size	PMS/ASASP
precipitation	sequential sampler
RO_2	radical-detector
O_3 and meteorological profiles	AIR
NO_2 profiles	Luminol

Aldergrove (mature chemistry) Site

Measurement	Instrument
O_3	TECO 49
NO/NOy	TECO 42S
NO_2	LMA-3
$HNO_3/NO_3^-/NH_3$	filterpack
PAN	GC/ECD
$RONO_2$	Cartridge
CO	TECO 48
VOCs	Canisters

Table II: Aircraft Measurement Program

Measurement	Instrument
Droplet Liquid Water Content	PMS King Probe
Droplet Liquid Water	Johnson Williams
Aerosol Spectrum (0.1-3 μm)	PMS PCASP 100X Probe
Aerosol/droplet spectrum (0.3-20 μm)	PMS FSSP 300 Probe
NO/NO_2	Unisearch LMA-3 NO/NO_2 Monitor
NO	Ecophysics
NOy	Monitor Labs
O_3	TECO 49 Analyzer
O_3	Unisearch LMA-3 O_3 Analyzer
SO_2	TECO 43S
CO	TECO 48 (mod)
H_2O_2	Kok
Aerosol filtering system	3 stage; H^+,Na^+,NH_4^+,K^+,Ca^{++},Mg^{++}, Cl^-,NO_3^-,SO_4^-,HNO_3,SO_2,NH_3
VOC	Canisters
PAN	GC
Aldehydes	Liquid Scrubbers
Aerosol Carbon	Aetholometer
Cloud and Precipitation Collectors	AES designed
Upwelling Solar Radiation	Eppley
Downwelling Solar Radiation	Eppley
Surface Brightness	Barnes PRT-5
Temperature	Rosemount (de-iced)
Temperature	Rosemount (non de-iced)
Temperature	NCAR
Dewpoint	Cambridge Hygrometer
Horizontal Winds; 3 axis gusts	IRS; Rosemount 858; TAS



LEGEND

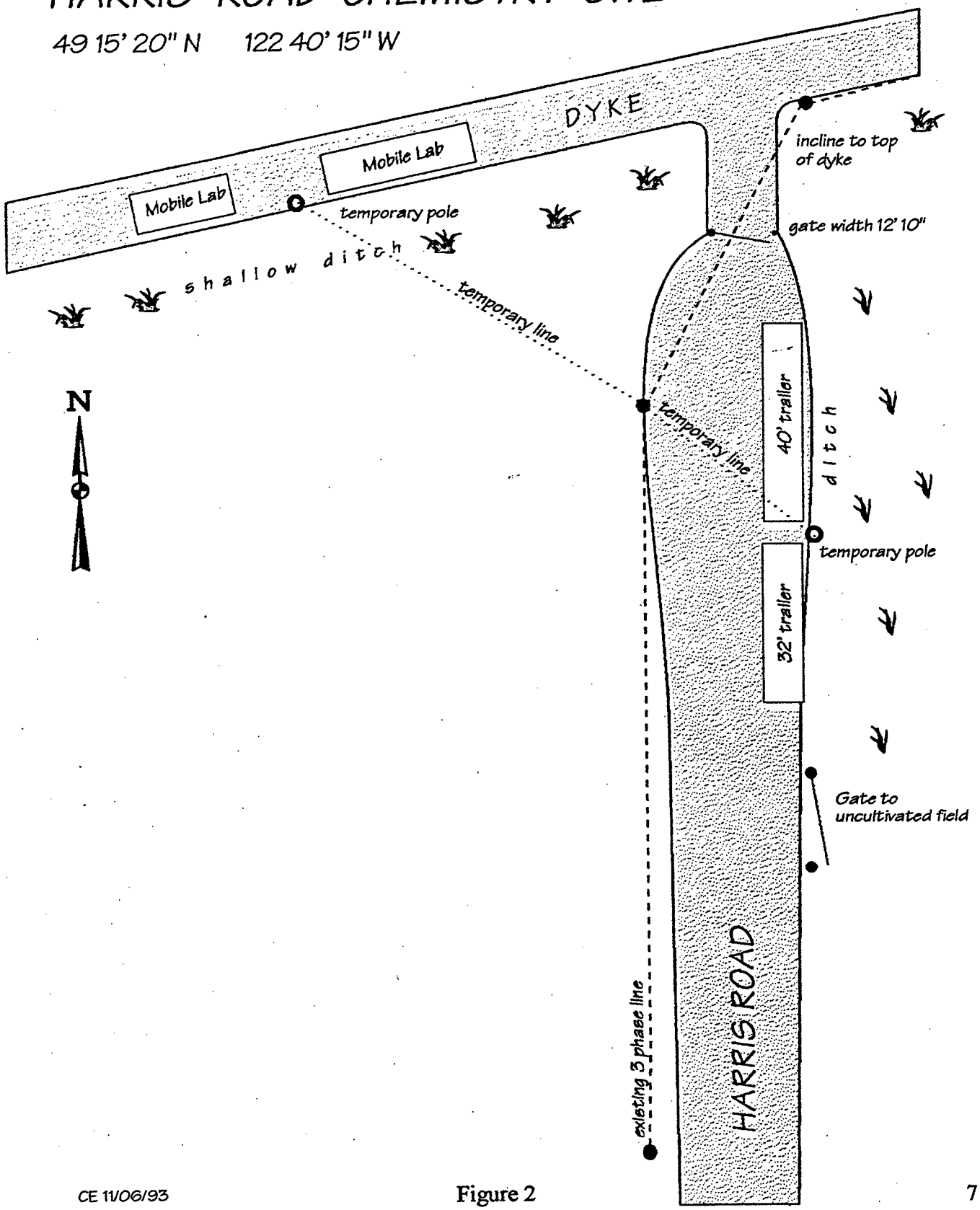
T1 Robson Square	T13 North Delta	Contour Interval = 300 metres
T2 Kitsilano	T14 Burnaby Mountain	
T3 Marpole	T15 Surrey East	
T4 Kensington Park	T16 Pitt Meadows	
T5 Confederation Park	T17 Richmond South	
T6 Second Narrows	T18 Burnaby South	
T7 Anmore	T21 Port Coquitlam North	
T9 Rocky Point Park	T26 Mahon Park	
T10 Eagle Ridge	T27 Langley	
T12 Chilliwack Works Yard	T28 Downtown Abbotsford	

0 10 20 km

Figure 1

HARRIS ROAD CHEMISTRY SITE

49 15' 20" N 122 40' 15" W



CE 11/06/93

Figure 2

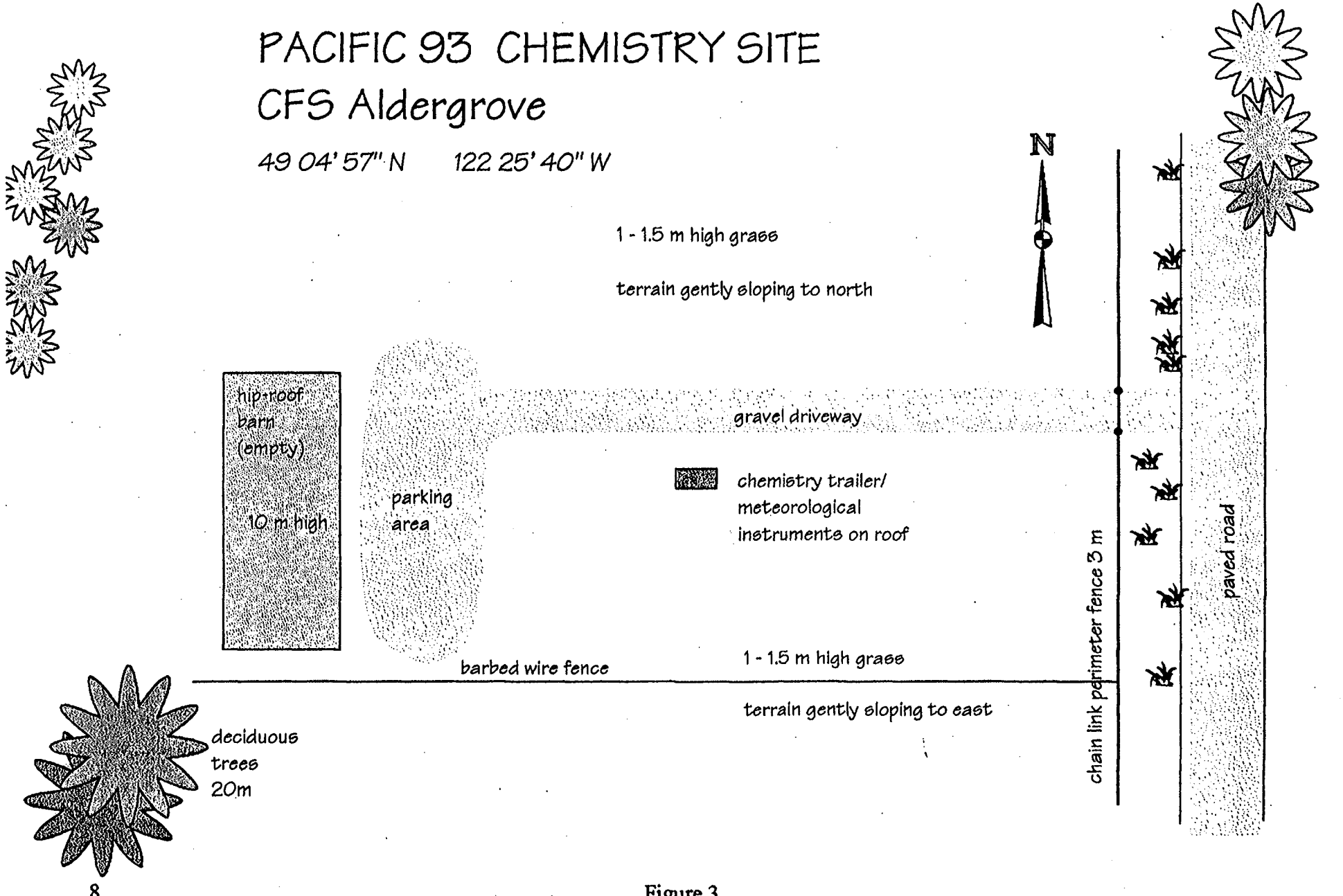

PACIFIC 93 CHEMISTRY SITE
CFS Aldergrove
49 04' 57" N 122 25' 40" W
N
1 - 1.5 m high grass
terrain gently sloping to north
hip-roof barn (empty)
10 m high
parking area
gravel driveway
chemistry trailer/ meteorological instruments on roof
chain link perimeter fence 3 m
paved road
barbed wire fence
1 - 1.5 m high grass
terrain gently sloping to east
deciduous trees 20m

Figure 3

PACIFIC 93 METEOROLOGICAL/OZONESONDE SITE

D. W. Poppy High School / GVRD Langley Central (T27)

23753-52nd Ave, Langley 49 05' 46" N 122 33' 59" W

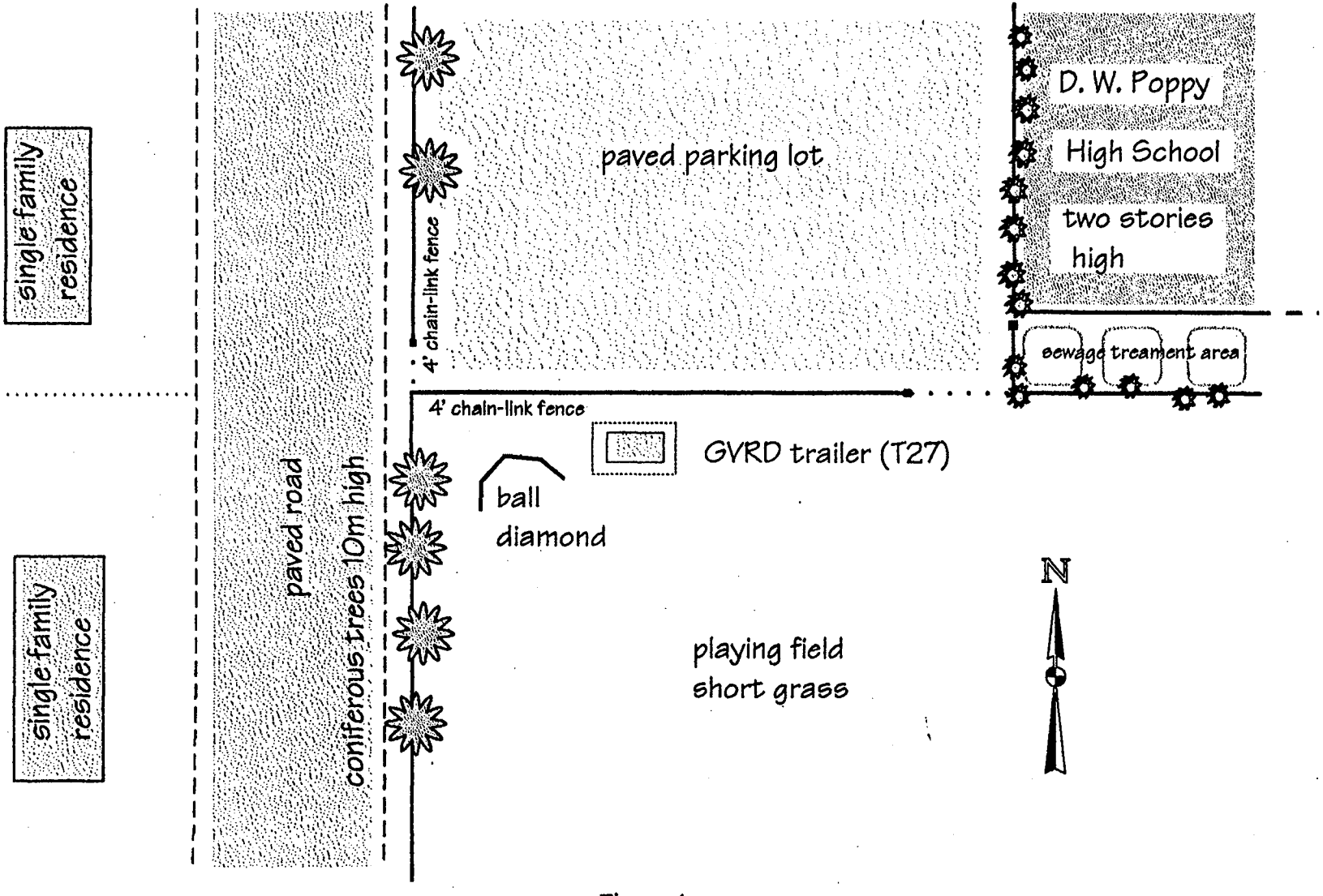
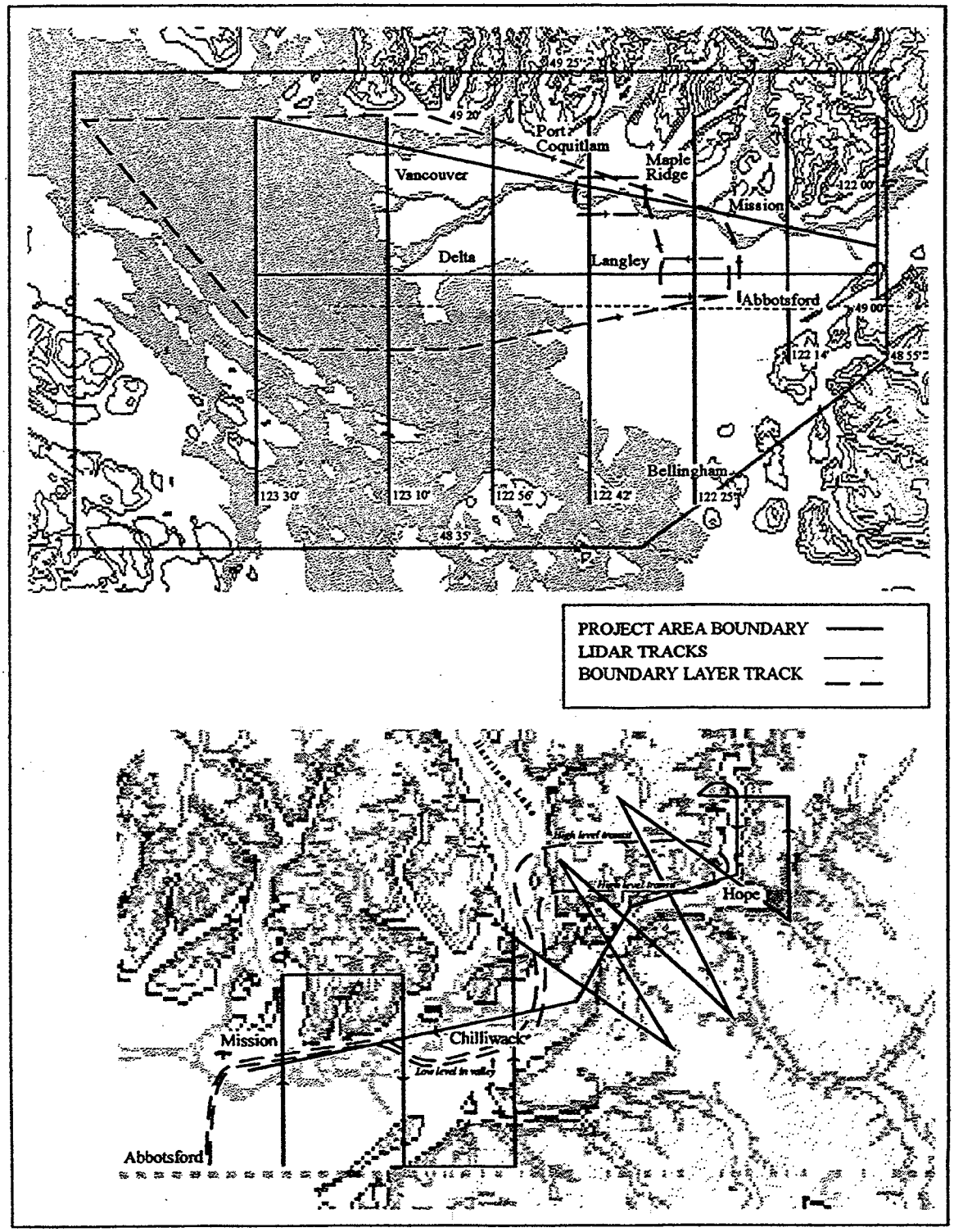


Figure 4



Field study sites in Lower Fraser Valley during Pacific 93.

Figure 5

Contact List for Principal Investigators

	Phone	Fax
UNIVERSITY OF BRITISH COLUMBIA		
Douw Steyn	(604) 822-6407	822-6150
Sara Pryor	(604) 822-2556	822-6150
Ian McKendry	(604) 822-4929	822-6150
Michael Brauer	(604) 822-9585	822-9588
Sverre Vedal	(604) 822-4927	875-4695
ENVIRONMENT CANADA		
Jan Bottenheim (ARQM)	(416) 739-4838	739-5704
Kurt Anlauf (ARQP)	(416) 739-4840	739-5708
Ray Hoff (ARQP)	(705) 458-3310	458-3301 (Egbert)
Al Wiebe (ARQP)	(416) 739-4837	739-5708
Shao-Meng Li (ARQP)	(416) 739-5731	739-5708
Bob Kessler (ARQM)	(416) 736-2100 Ext 40503	736-5345
Al Gallant (ARQM)	(416) 736-5211	736-5345
Fred Hopper (ARQM)	(416) 739-4872	736-5345
Walter Strapp (ARMP)	(416) 739-4617	739-4211
Dave Marcotte(NRC/IAR/FRL)	(613) 998-5578	952-1704
J. R. Brook (ARQP)	(416) 739-4916	739-5708
Brian Martin (AES, CARE)	(705) 458-3304	458-3301
Bruce Thomson (AISB, Pacific)	(604) 664-9122	664-9195
Joanne Pottier (AISB, Pacific)	(604) 664-9098	664-9195
Paul Shepson (York)	(416) 736-5313	736-5411
Don Hastie (York)	(416) 736-5388	736-5411
Peter Brickell (York)	(416) 736-2100 Ext 40555	736-5411
Sangeeta Sharma (York)	(416) 736-2100 Ext 40500	735-5411
Tony Basabe (WesternWash)	(206) 650-7285	650-7284
Steve Sakiyama (BCMoELP)	(604) 387-9942	356-7197
Richard Bennett (BCMoELP)	(604) 387-9939	356-7197
Al Percival (GVRD)	(604) 436-6746	436-6707
Fred Prystarz (GVRD)	(604) 436-6748 or 240-0705	436-6707
Patrice Rother (RDFC)	(604) 792-0061	792-9684
Tom Dann (C&P)	(613) 991-9459	998-4032
R.M.Banta (NOAA)	(303) 497-6593	497-5318

Table I:

Surface Measurement Program

Lower Fraser Valley Oxidants Study: July 15 - August 12, 1993

Surface Measurement Program

HARRIS ROAD 'Fast Chemistry' Site, Pitt Meadows 49 15 20 N 122 40 15 W

Marsh to about 30 metres on north side of dyke with Pitt River running east-west beyond marsh. Mountains north, delta south. Two trailers on dyke and two below. Harris Road is a primary IMPROVE sampler location in the REVEAL project.

MEASUREMENT / SPECIES	SAMPLER / ANALYZER	SAMPLING OR AVERAGING PERIOD	FREQUENCY	PRINCIPAL INVESTIGATOR	OPERATOR	COMMENTS
O3	UV Photometric Ozone Analyzer TECO-49	1 minute	continuous	Wiebe/Anlauf	Gaudenzi/Anlauf /Wiebe	
NO/NO2	Ecophysics	1 minute	continuous	Wiebe/Anlauf	Gaudenzi/Anlauf /Wiebe	
NO (nitrogen oxides)	Monitor Labs 8440	1 minute	continuous	Wiebe/Anlauf	Gaudenzi/Anlauf /Wiebe	
NOy	Monitor Labs 8440/ Au converter	1 minute	continuous	Wiebe/Anlauf	Gaudenzi/Anlauf /Wiebe	
CH2O (formaldehyde) H2O2 (hydrogen peroxide)	Tunable Diode Laser Spectrometer TAMS-150	1 minute	continuous	Kurt Anlauf	Gervase Mackay	
SO2	TECO43S	1 minute	continuous	Wiebe/Anlauf	Gaudenzi/Anlauf /Wiebe	
PAN	GC/ECD	15 or 30 minute intervals	24 hours/day	Gallant	Kovalick/Gallant	
CO	TECO 48	1 minute	continuous	Hopper	Kovalick/Gallant	
VOCs	GC/FID (Flame Ionization Detector) Chrompack analyzer	40 minutes out of every 90 minute period	24 hours/day during episode	Brickell	Kovalick/ Brickell	with cyrogenic preconcentration
VOCs	Canisters	30 seconds	2-3/week (doubled during episode)	Brickell	Brickell	sent to Toronto for analysis

MEASUREMENT / SPECIES	SAMPLER / ANALYZER	SAMPLING OR AVERAGING PERIOD	FREQUENCY	PRINCIPAL INVESTIGATOR	OPERATOR	COMMENTS
HNO3 / NO3- / SO4-2 / NH3 / Nh4 +	Filterpack sampler / Ion Chromatograph analyzer	3 hours	8/day	Wiebe/Anlauf	Gaudenzi/Anlauf / Wiebe	
HNO3 / NO3- / NH3 / HONO	Denuder sampler/ Ion Chromatograph analyzer	3 hours	8/day	Li	Kessler	some 6 hour and 1 hour samples
H2O2 (hydrogen peroxide) Total organic peroxides	Kok (Wet chemistry sampler and analyzer)	1 minute	continuous	Wiebe/Anlauf	Tham/Wiebe	Last half of study
RO2H / Speciated organic peroxides	HPLC (High Performance Liquid Chromatography)	1 minute	continuous	Wiebe	Tham/Wiebe	Last half of study
HNO3	UV Spectroscopy (sampler and analyzer)	instantaneous sample every 12 minutes	continuous	Li	Li	Last half of study
Methyl vinyl ketones Methacrolein Acetone	GC/MSD (Gas Chromatograph Mass Selective Detector)	8 minute integrated samples, 1 per hour	24 hrs/day	Shepson (York)	Biesenthal/Wu	
RONO2 (organic nitrates)	GC/ECD (Gas Chromatograph Electron Capture Detector)	2 hour samples	sporadic, except 12 / day during episode	Shepson (York)	Biesenthal/Wu	Charcoal used to trap nitrates. Samples sent to Toronto (York) for analysis
ROx (radicals) ROx = RO + RO2 + HO2 + HO	Chemical Amplifier (Made at York)	5 minutes	continuous	Hastie (York)	Arias	
Meteorology Tower						
Wind (speed and direction) Temperature Relative Humidity Pressure	Winds: RM Young Temperature:Rotronics	5 minutes	continuous	Anlauf / Wiebe	Gaudenzi/Anlauf	

MEASUREMENT / SPECIES	SAMPLER / ANALYZER	SAMPLING OR AVERAGING PERIOD	FREQUENCY	PRINCIPAL INVESTIGATOR	OPERATOR	COMMENTS
Tethersonde						
HARRIS ROAD Wind (speed and direction) Temperature Relative Humidity Pressure	3 cup anemometer/ magnetic compass (AIR)	10 seconds	July 26 Aug 1 - 6	Steyn (UBC)	Steyn/Pisano/ Kellerhaus/ Rucker	All instruments attached to balloon
O3	ozonesonde (AIR)	10 seconds	"	Steyn (UBC)		Using potassium iodide bubbles
NO2	luminol chemiluminescence (Scintrox/Unisearch)	5 seconds	"	Hastie (York)	Pisano	
PITT LAKE Wind (speed and direction) Temperature Relative Humidity O3	3 cup anemometer/ magnetic compass (AIR)	10 seconds	Jul 25, 26 Aug 1, 2	McKendry, UBC	McKendry	Used at Harris Rd after August 2nd
NO2 / NO3 / HONO/ Chemical absorption spectra between .36 -.65 microns	DOAS (Differential Optical Absorption Spectroscopy) includes SPEX 1870 0.5 Spectrometer	5 minutes	evenings and some days	Hoff	Sheppard/Hoff	
Particulates (0.2 - 5.0 microns)	PMS (Particle Mass Selective Sampler)/ ASASP (Active Spectrometer Aerosol Sampling Probe)	1 minute	continuous	Hoff	Guise-Bagley	Operated continuously July 15 - August 9
Particulate light scattering Bscat (visibility) Also monitoring RH,T, T-Td	Optec Nephelometer	2 minutes	continuous	Hoff	Guise-Bagley	Operated continuously July 15 - August 9
0.06 - 12.0 micron aerosols	Active Scattering Aerosol Spectrometer ASASP - X (Special)	1 minute	continuous	Hoff	Guise-Bagley	U/S - did not operate during study

MEASUREMENT / SPECIES	SAMPLER / ANALYZER	SAMPLING OR AVERAGING PERIOD	FREQUENCY	PRINCIPAL INVESTIGATOR	OPERATOR	COMMENTS
CFS ALDERGROVE 'SLOW CHEMISTRY' SITE 49 04 57 N 122 25 40 W						
On rolling hillside surrounded by trees with large building west						
O3	TECO 49	1 minute	continuous	Gallant	Ord/Iqbal	
NO	TECO 42S	1 minute	continuous	Gallant	Ord/Iqbal	
NO2	Luminol LMA/3	1 minute	continuous	Gallant	Ord/Iqbal	
NOy	TECO 42S	1 minute	continuous	Gallant	Ord/Iqbal	
RONO2	Charcoal cartridge	Overnight samples (12-14 hours) and other 2-8 hr samples	sporadic, except 12 / day during episode	Shepson (York)	Ord/Iqbal	Analyzed at York
PAN	GC	30 minutes	continuous	Gallant	Ord/Iqbal	
CO	TECO 48 mod	1 minute	continuous	Hopper	Ord/Iqbal	
VOCs	canisters	grab sample	4/day	Brickell	Ord/Iqbal	includes 1 replicate sample
VOCs	Sequential Canister Samples	3 hours	24 hours/day (8 samples)	Lavallee(AES)	Belzer	August 6. Part of AES VOC Sampling Program. Analysis done at C&P Ottawa (D Wang)
Wind Temperature Relative Humidity	RM Young CS207 Temp Probe	Wind - 10 minutes Temp - instantaneous	continuous	AES	Ord/Iqbal	AES Equipment set up by C Evans
HNO3 / NO3- / SO4 -2 / NH4+ / NH3	Filter pack	6 hour samples	continuous	Anlauf/Wiebe	Ord/Iqbal	Analysis in Downsview

MEASUREMENT / SPECIES	SAMPLER / ANALYZER	SAMPLING OR AVERAGING PERIOD	FREQUENCY	PRINCIPAL INVESTIGATOR	OPERATOR	COMMENTS
LANGLEY SITE 49 05 46 N 122 33 59 W						
Poppy School, GVRD Site. Sondes launched in large baseball/playing field next to school. Trees approx 50 m north of trailer. Elevation 82 m asl						
Wind (speed and direction) Temperature Relative Humidity Pressure O3	VIZ Ozonesonde	1 -2 hours	5/day during episode	AES	Evans/Froude /Martin	
O3	TECO 49	1 minute	continuous		GVRD (Al Percival)	
Wind (speed and direction) Temperature Relative Humidity Pressure	Radiosonde (same as Ozonesonde without O3 sampler attached)	1-2 hours	As required for flight preparation	AES	Evans/Froude /Martin	
Solar Radiation	Eppley solarimeter		continuous	AES	Martin/Froude	
Wind(Speed and Direction)	MET-ONE	1 minute samples averaged for the hour (only hourly values available)	continuous		GVRD	
Temperature	MET-ONE	1 minute samples averaged for the hour (only hourly values available)	continuous		GVRD	
NO/ NO2/ NOx	Chemiluminescence TECO 42	1 hour	continuous		GVRD	
CO	Gas Filter Correlation Analyzer TECO 48	1 hour	continuous		GVRD	
COH	BVM	1 hour	continuous		GVRD	
PM10 (Particulates)	TEOM 1400A	1 hour	continuous		GVRD	

MEASUREMENT / SPECIES	SAMPLER / ANALYZER	SAMPLING OR AVERAGING PERIOD	FREQUENCY	PRINCIPAL INVESTIGATOR	OPERATOR	COMMENTS
TSP	GMW-2000	24 hour	1 per 6 days		GVRD	
VOCs	Canister	sequential (3 hours)	8/day	Lavallee (AES, Toronto)	Belzer (AES, Pacific)	Part of VOC Sampling Program (Aug 2 - 4)
PITT MEADOWS AIRPORT 49 12 59 N 122 42 31 W						
Located approx 5 km south of Harris Road Site, on dyke south of Pitt Meadows Airport. Elevation 6 m asl						
Boundary Layer Wind Structure (Sea breeze and terrain induced flows)	NOAA Wave Propagation Laboratory Doppler Lidar	3-4 hours	daily	Banta/ Hardesty	Olivier/Banta/ Hardesty	August 1 - 6
VISIBILITY	See REVEAL Network					
SURFACE ENERGY AND RADIATION						
Measurements taken at Sunset Tower (49th & Knight St) during the period August 2 - 6. All measurements except temperature wer taken at a height of 27. 5 m above ground. Temperature was measured at a height of 19 m. This does not take into account that the base of the tower is 5 m below the base of the surrounding land.						
Temperature (T)	Copper-Constantan thermocouple	10 sec sampling 15 min averaging	continous	Steyn/Oke	Rucker	July 31 - Aug 6
Wind Speed / Direction (u)	MET- ONE wind direction and speed sensor	10 sec sampling 15 min averaging	continous	Steyn/Oke	Rucker	July 31 - Aug 6
Net Radiation (Q*)	Swissteco Net Radiometer	10 sec sampling 15 min averaging	continous	Steyn/Oke	Rucker	July 31 - Aug 6

MEASUREMENT / SPECIES	SAMPLER / ANALYZER	SAMPLING OR AVERAGING PERIOD	FREQUENCY	PRINCIPAL INVESTIGATOR	OPERATOR	COMMENTS
Kinematic Sensible Heat Flux (w'T')	Campbell Scientific sonic anemometer/ thermocouple	0.1 sec sampling 15 min averaging	continous	Steyn/Oke	Rucker	July 31 - Aug 6
WESTHAM ISLAND 49 05 15 N 123 10 15 W						
O3	Daisibi	1 minute	continuous	Gallant	Gallant	August 1-6
DMS (dimethylsulfide)	13 cartridge samplers	5-10 minute samples		Sharma	Gallant /Gillies	August 1-6 Samples sent to Toronto for analysis by Sharma
NORTHWEST WASHINGTON OXIDANT MONITORING (Whatcom and Skagit Counties)						
LYNDEN, WA						
O3	UV Photometric Dasibi 1008 PC	1 hour		Basabe	Basabe/Cope/ Portnoff	Measurement Period 4/5/93 - 10/6/93
NOx, NO, NO2	Chemiluminescence Monitor Labs 8440	NO2 1 hour	continuous	Basabe	Basabe/Cope/ Portnoff	7/17/93 - 10/6/93
VOCs	Evacuated Canister Indacor	8 hour samples		Basabe	Basabe/Cope/ Portnoff	9/2/93 - 9/4/93
Wind Speed	Cup Anemometer Climatronics EWS		continuous	Basabe	Basabe/Cope/ Portnoff	7/17/93 - 10/6/93
Wind Direction	Vane Climatronics EWS		continuous	Basabe	Basabe/Cope/ Portnoff	7/17/93 - 10/6/93
Temperature	Thermistor Climatronics EWS		continuous	Basabe	Basabe/Cope/ Portnoff	7/17/93 - 10/6/93

MEASUREMENT / SPECIES	SAMPLER / ANALYZER	SAMPLING OR AVERAGING PERIOD	FREQUENCY	PRINCIPAL INVESTIGATOR	OPERATOR	COMMENTS
SUMAS, WA						
O3	UV Photometric Dasibi 1003 PC	minute/hour	continuous	Basabe	Basabe/Cope/ Portnoff	Measurement Period 7/13/93 - 10/6/93
NOx, NO, NO2	Chemiluminescence Monitor Labs 8440E	minute/hour	continuous	Basabe	Basabe/Cope/ Portnoff	7/22/93 - 10/6/93
Wind Speed	Cup Anemometer Climatronics EWS	minute/hour	continuous	Basabe	Basabe/Cope/ Portnoff	7/11/93 - 10/6/93
Wind Direction	Vane Climatronics EWS	minute/hour	continuous	Basabe	Basabe/Cope/ Portnoff	7/11/93 - 10/6/93
Solar Radiation	Pyranometer Sensor LiCor Li-200SA	1 hour		Basabe	Basabe/Cope/ Portnoff	8/13/93 - 10/6/93
Temperature	Thermistor Climatronics EWS	minute/hour	continuous	Basabe	Basabe/Cope/ Portnoff	7/11/93 - 10/6/93

GVRD NETWORK

All measurements averaged over 1 hour period and measured continuously. * Indicates data coverage does not extend through full study period. (July 15 - August 12). See VOC Sampling Program for extra samples taken at GVRD sites during study.
T9 sampled every NAPS day for VOC (24 hours) and Aldehydes. A VOC sampler is rotated among the following Index Stations on NAPS days: T1, T4, T15, T17, T26, T27. Approximately 20 VOC samples (24 hours) are obtained from T22 during the year

MEASUREMENT / SPECIES	LOCATION	IDENTIFIER	LATITUDE	LONGITUDE	ELEVATION (M)	COMMENTS
CO NO2 O3 SO2 COH VOC	Robson Square	T1	49 16 58	123 07 14	56	* SO2: Jul 28-Aug 5 O3: Jul 15 - Aug 6
TSP PM10	BC Hydro	T1A	49 16 54	123 07 24	59	
CO NO2 O3 SO2 TSP PM10 WIND	Kitsilano	T2	49 15 45	123 09 45	63	*
CO NO2 O3 TSP	Marpole	T3	49 12 35	123 06 50	27	Operation ceased May 6/93
CO NO2 O3 SO2 TRS COH TSP WIND	Kensington Park	T4	49 16 45	122 58 11	133	* SO2: July 15
CO NO2 O3 SO2 TRS TSP TEMP WIND	Confederation Park	T5	49 17 00	122 59 52	101	* CO:Jul 28 - Aug 12 NO2:Jul 28-Aug 12
CO NO2 O3 SO2 WIND	Second Narrows	T6	49 18 08	123 01 08	< 15	
CO NO2 O3 SO2 TRS TSP TEMP WIND	Anmore	T7	49 18 40	122 51 30	174	* SO2:Jul 15 - Aug12
O3	Lion's Gate	T8	49 19 05	123 08 05	< 15	* O3: Jul 19 - Aug 5
CO NO2 O3 SO2 TRS COH TSP VOC PM10 TEMP WIND UV	Rocky Point	T9	49 16 51	122 50 53	< 15	* COH: Jul 16 - 20

MEASUREMENT / SPECIES	LOCATION	IDENTIFIER	LATITUDE	LONGITUDE	ELEVATION (M)	COMMENTS
CO NO2 O3 SO2 TSP	Eagle Ridge	T10	49 17 05	122 49 26	52	
O3	Abbotsford Airport	T11	49 01 50	122 22 34	58	* BCMoE Station
CO NO2 O3 COH PM10	Chilliwack Works Yard	T12	49 09 09	121 57 03	10	* BCMoE Station O3: Juk 15 - Aug 12 NO2: Aug 10-12
NO2 O3 TSP TEMP WIND	North Delta	T13	49 09 30	122 54 03	140	WIND: Jul 15 - 27
NO2 O3 TSP TEMP WIND	Burnaby Mtn	T14	49 16 45	122 54 42	360	
CO NO2 O3 COH TSP VOC TEMP WIND	Surrey East	T15	49 07 58	122 41 36	79	* O3: Jul 15
CO NO2 O3 SO2 COH PM10 WIND TEMP	Pitt Meadows Apt	T16	49 12 46	122 42 28	< 15	* BCMoE Station COH:Jul 28 - Aug 4 NO2: Aug 5 - 12
CO NO2 O3 SO2 COH TSP VOC TEMP WIND	Richmond South	T17	49 08 31	123 06 28	< 15	
CO NO2 O3 SO2 TSP TEMP WIND	Burnaby South	T18	49 12 56	122 58 57	145	* CO: Jul 27 - Aug 4
NO2 TSP TEMP WIND	Richmond East	T19	49 11 05	123 02 28	< 15	
NO2	Burnaby East	T20	49 12 20	122 57 07	113	*
O3	Port Coquitlam North	T21	49 16 48	122 44 03	32	* O3: Aug 8 - 9
TRS THC VOC	Burmount, Burnaby	T22	49 16 56	122 52 40	151	
O3	Burnaby Lake	T24	49 15 03	122 57 42	43	Discontinued

MEASUREMENT / SPECIES	LOCATION	IDENTIFIER	LATITUDE	LONGITUDE	ELEVATION (M)	COMMENTS
O3 TSP	Seymour Falls, N Van	T25	49 26 14	122 57 54	220	Seasonal * O3: Aug 5 - 10
CO NO2 O3 SO2 COH VOC	Mahon Park, N Van	T26	49 19 28	123 04 58	95	* COH: Jul 17 -22
CO NO2 O3 COH VOC WIND	Langley Central	T27	49 05 46	122 33 59	82	* COH: Jul 27 - 29
CO NO2 O3 COH PM10	Downtown Abbotsford	T28	49 02 58	122 17 33	20	

VOC SAMPLING PROGRAM

Several VOC samples were taken to provide support and data verification for the Lower Fraser Valley Oxidants Study.
Sampling methods included 3 hour samples during a 24 hour period (S = sequential), and 24 hour samples (D = daily).
The program was under the direction of Francois Lavellee, and was an extension of the Cassiar Tunnel Study.

LOCATION	SAMPLING METHOD	DATE	LAND TYPE	PRINCIPAL INVESTIGATOR	OPERATOR	COMMENTS
T9 Port Moody	S and D	July 6, 12, 18, 24,30 Aug 5, 11, 17, 23,29	Industrial	Belzer (AES, Pacific)	Belzer (AES Pacific)	Part of NAPS Program
T17 Richmond	S	July 28	Residential	"	"	
T27 Langley	S	August 2,4	Rural	"	"	
Aldergrove	S	August 6	Farming	"	"	D Method Carbonyl samples taken July 26, 28, 30 and August 2,4 6
Pitt Meadows (Harris Road Site)	D and 2 grab samples/day	July 20, 21	Rural	"	"	D Method Carbonyl samples taken July 26, 28, 30 and August 2,4 6. Analysis by Danny Wong in Ottawa, C&P
T17 Richmond	D	July 26, 28, 30 August 2, 4, 6	Residential	"	"	
T27 Langley	D	July 26, 28, 30 August 2, 4, 6	Rural	"	"	
T2 Kitsilano	D	July 26, 28, 30 August 2, 4, 6	Residential	"	"	

OTHER MEASUREMENTS (Not All Identified as Part of Lower Fraser Valley Oxidants Study)

REVEAL NETWORK

Aerosol and visibility measurements co-ordinated and sponsored by BC Minstry of Envrionment, Lands and Parks.

Measurement period July 1 - August 31, 1993

MEASUREMENT	LOCATION	EQUIPMENT	FREQUENCY	PRINCIPAL INVESTIGATOR	OPERATOR	COMMENTS
Aerosols < 2.5 um (see Note 1)	UBC	IMPROVE Module A	continuous, daily samples	Sakiyama (MELP)	D. Ciarniello (UBC)	Top of Geography Building. Filter cassettes analyzed at U. of Calif., Davis
Aerosols < 2.5 um (see Note 1)	White Rock	IMPROVE Module A	continuous, daily samples	Sakiyama	D. Ciarniello (UBC)	Top of Municipal Hall Filter cassettes analyzed at U. of Calif., Davis
Aerosols < 2.5 um (see Note 1)	Langley	IMPROVE Module A	continuous, daily samples	Sakiyama	D. Ciarniello (UBC)	Top of Langley Hospital Filter cassettes analyzed at U. of Calif., Davis
Aerosols < 2.5 um (see Notes 1, 2 and 3)	Pitt Meadows (Harris Road Site)	IMPROVE Modules A, B, C	continuous, daily samples	Sakiyama	D. Ciarniello (UBC)	Filter cassettes analyzed at U. of Calif., Davis

MEASUREMENT	LOCATION	EQUIPMENT	FREQUENCY	PRINCIPAL INVESTIGATOR	OPERATOR	COMMENTS
Aerosols < 2.5 um (see Notes 1 and 2) Relative Humidity Light Scattering	Clearbrook Agricultural Substation	IMPROVE Modules A, B Nephelometer DRUM Sampler (see Note 4)	IMPROVE samples: continous, daily Nephelometer: continuous, 5 min averages RH: continuous, 5 min averages DRUM Sampler: continuous, 6 hr intervals	Sakiyama	D. Ciarniello (UBC)	1 km SE of Abbotsford Airport. Data accessed remotely. Filter cassettes analyzed at U. of Calif., Davis
Aerosols < 2.5 um (see Notes 1, 2 and 3) Relative Humidity Light Extinction Light Scattering	Chilliwack / Sardis (Transmissometer on Mt Shannon looking across to Promontory Heights)	IMPROVE Modules A, B, C Nephelometer Transmissometer (path length 7 km)	IMPROVE samples: continuous, daily Nephelometer: continuous, 5 min averages RH: continuous, 5 min averages Transmissometer: continuous, 1 min averages	Sakiyama	3 Residents	Resident's back yard. Filter cassettes analyzed at U. of Calif., Davis. Transmissometers, nephelometer, and RH data accessed remotely
Aerosols < 2.5 um (see Note 1)	Agassiz Agricultural Station	IMPROVE Module A	continuous, daily samples	Sakiyama	Agassiz personnel	Filter cassettes analyzed at U. of Calif., Davis.
Aerosols < 2.5 um (see Note 1)	North of Ucluelet, Pacific Rim National Park, west coast of Vancouver Island	IMPROVE Module A	continuous, daily samples	Sakiyama	Park personnel	At Park Admin. Office, near beach. Filter cassettes analyzed at U. of Calif., Davis.

MEASUREMENT	LOCATION	EQUIPMENT	FREQUENCY	PRINCIPAL INVESTIGATOR	OPERATOR	COMMENTS
Aerosols < 2.5 um (see Note 1and 2)	Nanoose Bay, DND Site, east coast of Vancouver Island	IMPROVE Module A, B	continuous, daily samples	Sakiyama	Nanaimo Regional Office	Just south of Parksville. Filter cassettes analyzed at U. of Calif., Davis.
Aerosols < 2.5 um (see Note 1)	Beaver Creek Ranch, inland 240 km NE of urban Vancouver	IMPROVE Module A	continuous, daily samples	Sakiyama	Kamloops Regional Office and Ranch personnel	50 km NE of Merritt, about 4000 feet asl. Filter cassettes analyzed at U. of Calif., Davis.
Total Light Extinction	Chilliwack REVEAL Site	Intercavity Extinctiometer	continuous (1 minute sampling period)	Pryor/Horn (UBC/ Digilog, Colorado)	Pryor	Experimental. Data downloaded to CS datalogger and operated remotely. Analyzed by Sara Pryor, UBC
Scene	Mt. Seymour	Time lapse and 35 mm camera	Time Lapse: 1 frame/minute 0600 - 1930 PST Camera: 8/day, 0700-1830 PST	Sakiyama	Mt. Seymour Resort personnel	facing Mt. Baker
Scene	Abbotsford Airport Tower	35 mm camera	8/day: 0700 - 1830 PST	Sakiyama	D. Ciarniello (UBC)	facing Sumas Mountain

MEASUREMENT	LOCATION	EQUIPMENT	FREQUENCY	PRINCIPAL INVESTIGATOR	OPERATOR	COMMENTS
Scene	Chilliwack Hospital	35 mm camera	8/day: 0700 - 1830 PST	Sakiyama	P. Rother D. Ciarniello	facing toward Mt. Cheam
Scene	Hope	35 mm camera	8/day: 0700 - 1830 PST	P. Rother	P. Rother	Part of program initiated by Fraser-Cheam Regional District

Note 1: Module A analysis to produce coefficient of absorption, total mass, concentration, elements: H, Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Sn, As, Br, Rb, Sr, Zr, Mo, Pb

Note 2: Module B analysis to produce: NO3-, Cl-, SO4 -2, NO2, NH4 +

Note 3: Module C analysis to produce low and high temperature organic and elemental carbon

Note 4: Fractionation of S aerosols into 8 size ranges

CASSIAR TUNNEL FIELD STUDY

August 13 to August 18 - Joint Study involving GVRD and Environment Canada. Overseen by Desert Research Institute, Reno, Nevada.
Field Coordinator was Wayne Belzer, AES (for Francois Lavallee and Tom Dann, C&P, Ottawa)
Tunnel length is 730 m and face opening is 88.843 m3. Slope of tunnel is +1.66 % at south entrance and -1.29% at north exit.

MEASUREMENT / SPECIES	SAMPLER / ANALYZER	SAMPLING OR AVERAGING PERIOD	FREQUENCY	PRINCIPAL INVESTIGATOR	OPERATOR	COMMENTS
Traffic flow in and out of tunnel	video tapes	one hour	All Times in PST August 13: 01-02, 05-06, 09-10, 14-15 August 14: 08-09 August 15: 08-09 August 16: 01-02, 05-06, 07-08 August 17: 0630-0730, 15-16 August 18: 01-02, 05-06, 07-08, 09-11, 11-12, 13-14, 15-16	DRI (Gertler/Wittorf)	Belzer (AES)/ Prystarz(GVRD)	tapes sent to C&P, Ottawa for anlysis of vehicle type and count
NOx/ NO/ NO2/ CO	32 Tedlar bag samples/ TECO Analyzer	one hour		Belzer (AES)/ Prystarz(GVRD)	same	NOx/NO/NO2/CO analyzed on site in GVRD monitor trailer
Total Hydrocarbons	Part of 32 Tedlar bag samples	one hour		Belzer (AES)/ Prystarz(GVRD)	same	Analyzed by GVRD
VOCs	32 Stainless Steel Canisters/GC Mass Spectrometer Analyzer	one hour		DRI (Gertler/Wittorf)	same	Analyzed by C&P (Danny Wang)
High Molecular Weight Hydrocarbons	22 Tenax tube samples/GC Analyzer	one hour		DRI (Gertler/Wittorf)	Belzer/Gertler/ Wittorf	Analyzed by DRI in Reno
Aldehydes/Carbonyls	25 Samples/HPLC Analyses	one hour		Belzer (AES)/ Prystarz(GVRD)	same	Analyzed by C&P (Danny Wang)
Organics	1 gallon US gasoline samples of all brands, including leaded	grab samples	single sample		Thomson (AES)	Analyzed by Esso & Imperial Oil, Sarnia, Ont

GLADWIN ROAD 49 06 00N 122 19 50W						
UBC contracted by Health Canada. Located approx 5 km north of Clearbrook on berry farm. Operated early July to late August						
MEASUREMENT / SPECIES	**SAMPLER / ANALYZER**	**SAMPLING OR AVERAGING PERIOD**	**FREQUENCY**	**PRINCIPAL INVESTIGATOR**	**OPERATOR**	**COMMENTS**
O3	Daisibi	1 minute	continuous	Belzer(AES)	Belzer (AES)	
Wind Temperature Relative Humidity	Wind: RM Young T & RH: CS207 Probe	Wind - 10 minutes Temp - Instantaneous	continuous	Belzer (AES)	Belzer/Gillies	
PM10	Impactor with pump	6 am - 8:30 am	daily	Brauer (UBC)	Blair(UBC)	Analyzed at UBC
Lung Function	Spirometer Test	40-60 berry pickers	twice/day	Brauer/Brook /Vedal	Blair (UBC) / Vedal	
O3	Dossimeter (Badge coated with Ki/Na2CO3) Worn by berry pickers and one placed close to O3 Analyzer for calibration	worn 12 hours/day	15 berry pickers / day	Brauer	Blair and other UBC students	Analyzed at UBC. Operated during study at Lalli Farm
ACID AEROSOL STUDY						
Surrey East - GVRD Network Surrey East 49 07 58N 122 41 36 W AES/ UBC/ GVRD/ Health Canada joint study. Operated late June - September 18. Site is T15 in GVRD network						
p-H+, p-SO4, p-NO3, p-NH4, SO2, HNO3, HONO, NH3	Annular denuder system	24 hour sample	daily	Brook(AES)	GVRD	Analyzed at UBC and at C&P, Ottawa
O3	Dossimeter placed close to GVRD O3 Analyser for calibration			Brauer	Blair (UBC)	
Note: p- denotes particulates < 2.5 um						

Table II:

Aircraft Measurement Program

Lower Fraser Valley Oxidants Study: July 15 - August 12, 1993

Aircraft Measurement Program

National Research Council Convair 580 Aircraft. Tracks flown from Strait of Georgia to Hope and included northern Washington state in north - south traverses. Tracks flown at 4000m and 500 m with spirals over main sites. A/C based at Abbotsford Airport in Conair Hangar

State Parameters	Measurement	Instrument	
	Temperature	Rosemount Temperature Sensor (de-iced)	
	Temperature	NCAR design reverse flow temperature	
	Dewpoint	Cambridge Dewpoint Hygrometer (chilled mirror)	
	Static Pressure	Static Pressure Port on nose, in PMS 858 probe and on Scalar pylon	
	Aircraft Altitude	Bendix radar altimeter (<800 m)	
	True Airspeed	Pitot under wing (CV580) with Rosemount 858 and on Scalar pylon	
Navigational Systems	Position	IRS (Litton 91), and LORAN	
	Position	GPS (CV580: Marconi and Northstar)	
	Attitudes, Accelerations, True Heading, and Ground	IRS (Litton 91)	
	3 Axis Velocities wrt Ground	IRS (Litton 91) and DECCA Doppler	

	Measurement	Instrument	
Winds and Gusts	Horizontal Winds, and 3 Axis Gust Velocities	IRS (inertial velocities), Rosemount 858 (attitudes) and TAS derived	
Cloud Microphysical Measurements	Droplet Liquid Water Content	PMS King Probe (long version)	
	Droplet Liquid Water	Johnson Williams LWC Meter	
	Aerosol Spectrum (dried) (0.2 - 3 um)	PMS ASASP - 100X Probe	Failed part of project
	Aerosol/Droplet Spectrum (hydrated) (0.3 - 20 um)	PMS FSSP 300 Probe	
Air and Cloud Chemistry	NO2	Unisearch Model LMA-3 NO2 Monitor	Second half of project
	NO	Ecophysics Model CLD780TR Analyzer	
	NOy	Monitor Labs Au converter	
	O3	TECO Model 49 Analyzer	
	CO	Modified TECO Model 48	Quits at 10000 ft PI Hopper
	Aerosol Filtering System (One system with forward facing isometric inlet, stainless steel, for aerosols; second system with back facing non-isometric teflon sleeved inlet for gases	3 Stage Filter System with Whatman 41 Filters:	
		1st Stage:Aerosol (H+, Na+, NH4+, K+, Ca++, Mg++, Cl, NO3-, SO4-)	
		2nd Stage: HNO3 (nylon)	
		3rd Stage: SO2 (KCL impregnated) or NH3 (citric acid impregnated)	

	Measurement	Instrument	
Air and Cloud Chemistry (cont'd)	VOCs	Evacuated Stainless Steel Canisters	
	PAN	Gas Chromatograph, Electron Capture	LPA-4 not run
	Aldehydes	Liquid Scrubbers (peristaltic)	
	Cloud and Precipitation Collectors	AES Heated Fixed Design for Warm and Supercooled Collection	
	CH2O	Liquid scrubber flourescence technique	Experimental. Only a few flights of data
	Acetic Acid HNO3 formic acid	Mist chamber	Run most of flights. Levels very low
Remote Profiling	Aerosol Backscatter Profiles	Downward Looking Nd - YAG Lidar (1um)	
	Downwelling Solar Radiation	Eppley UV Radiometers	UVb
	Upwelling Solar Radiation	Eppley UV Radiometer	UVb
Data Recording and Display	Aircraft Data Systems	IAR MicroVAX, AES SEA Model 200 DAS	

Daily Log

- *Aircraft Flights*
- *Tethersonde and Ozone Releases*
- *DOAS, NOAA Lidar, and Nephelometer Operations*

Lower Fraser Valley Oxidants Study: July 15 - August 12, 1993
Daily Log

JULY	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Convair 580 Flight (AM)					X							X	X				
(PM)										X							X
Tethersonde (Harris Road) A:ascending D:descending (All Times in PST)												1456A 1511D 1535A 1552D					
Tethersonde (Pitt Lake)											X	X					
DOAS (Harris Road)			X		X	X	X	X	X		X	X	X	X	X	X	
Radiosonde (met only) Langley					13PST				10PST			07PST	05PST			05PST	
Ozonesonde (Langley)									03PST			13PST					14PST 17PST
NOAA Lidar (Pitt Meadows Airport)																	
Particulates & Nephelometer (Harris Road)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

July 30: Morning flight cancelled due to cloud below 14000 feet

Lower Fraser Valley Oxidants Study: July 15 - August 12, 1993
Daily Log

AUGUST	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th
	1	2	3	4	5	6	7	8	9	10	11	12
Convair 580 Flight (AM)	X	X	X		X	X				X		
(PM)	X		X	X	X	X						
Tethersonde (Harris Road) All Times in PST	0642 0737 0942 1100 1305 1448 1654 1746	0715 0833 1241 Lost Balloon	1135 1248 1400	0915 1021 1140 1300 1451	0819 0925 0950 1020 1107 1207 1255 1417 1509 1632 1726 1805	0720 0842 0951 1031 1122 1220 1305 1359 1450 1537 1629 1726 1752						
Tethersonde (Pitt Lake)	X	X	Balloon used at Harris Site									
DOAS (Harris Road)	X	X	X	X	X	X						
Radiosonde (met only) Langley										05 PST		
Ozonesonde (Langley) All Times in PST	04 10 14 16 19	04 10 13 16	04 10 13 16	04 10 13 16	04 10 13 16	04 10 13 16						
NOAA Lidar (Pitt Meadows Airport) All Times in PST	11-14 15-1730	21-2220 09-1345 1352-1845	1856-2105 2133-2322 0351-0541 0640-0818	0407-0545 0956-1206 1238-1517 1527-1738	1744-2112 2136-0037 0052-0305 0315-0542 0609-0916 0926-1224	0611-0844 0904-1158 1328-1537 0335-0547						
Particulates & Nephelometer (Harris Road)	X	X	X	X	X	X	X	X	X			

August 6-8: Abbotsford Airshow

August 2: Balloon lost at Harris Site. Pitt Lake Balloon used after this.

NOAA Lidar: Generally 14 km range

Pitt Meadows Balloon Soundings

DATE	FLIGHT#	TIME	MET	O3	NO2	COMMENTS
Jul 26	2A	14:56:00	Y	Y	Y	Ascending
	2D	15:11:00	Y	Y	Y	Descending
	3A	15:35:00	Y	Y	Y	Ascending
	3D	15:52:00	Y	Y	Y	Descending
Aug 01	4	06:42:06	Y	N	Y	
	5	07:37:33	Y	Y	Y	
	6	09:42:23	Y	Y	Y	
	7	11:00:50	Y	Y	Y	
	8	13:05:58	Y	Y	Y	
	9	14:48:00	Y	Y	N	Up to 150 m
	10	16:54:50	Y	N	Y	
	11	17:46:10	Y	Y	Y	
Aug 02	12	07:15:30	Y	Y	Y	
	13	08:33:45	Y	Y	Y	
	14	12:41:43	Y	Y	Y	Lost Balloon on Descent
Aug 03		11:35:00	Y	Y	N	
		12:48:00	Y	Y	N	
		14:00:00	Y	Y	N	
Aug 04		09:15:00	Y	Y	N	
		10:21:00	Y	Y	N	
		11:40:00	Y	Y	N	
		13:00:00	Y	Y	N	
		14:51:00	Y	Y	N	
Aug 05	15	08:19:50	Y	N	N	
	15N	09:25:46	N	N	Y	
	16	09:50:00	Y	N	N	
	17	10:20:00	Y	N	N	
	17N	11:07:11	N	N	Y	
	18	12:07:00	Y	Y	N	
	19	12:55:00	Y	N	N	
	19N	14:17:11	N	N	Y	
	20	15:09:00	Y	N	N	
	20N	16:32:41	N	N	Y	
	21	17:26:00	Y	Y	N	
	22	18:05:00	Y	Y	N	
Aug 06	23	07:20:00	Y	Y	N	
	23N	08:42:42	N	N	Y	
	24	09:51:00	Y	Y	N	
	24N	10:31:21	N	N	Y	
	25	11:22:00	Y	Y	N	
	26	12:20:00	Y	Y	N	
	27	13:05:00	Y	Y	N	
	28	13:59:00	Y	Y	N	
	29	14:50:00	Y	Y	N	
	30	15:37:00	Y	Y	N	
	30N	16:29:24	N	N	Y	
	31	17:26:00	Y	Y	N	
	32	17:52:00	Y	Y	N	

All Times in PST (Z + 8)

Meteorology Log

Daily Record of Synoptic

and Mesoscale Features

Lower Fraser Valley Oxidants Study: July 15 - August 12th
Meteorology Log

Temperatures and heights extracted from UIL (Quillayute) tephigrams. UIL is at sea level. ** Missing tephigrams. T/T-Td estimated from Upper Air reports

JULY	Synoptic/ Upper Pattern	Surface	YVR max (C)	YVR Wind 6 am PST (14z)	YVR Wind 2 pm PST (22z)	YXX max (C)	YXX Wind 6 am PST (14z)	YXX Wind 2 pm PST (22z)	850 hPa Height (m) T/T-Td (C)	700 hPa Height (m) T/T-Td (C)	Z hr 12Z = 0400 PST 00Z = 1600 PST
Th 15	NE-SW trough over southern mainland with short waves circulating around Low over Vancouver Island. High pressure cell south of Aleutians extends over eastern Pacific and is retrogressing	BKN - OVC with embedded TCU/ CB (Towering Cumulus/ Cumulonimbus). Very unstable. Heavy rain warnings out for Fraser Valley. Rain in morning with clear patches in afternoon	16.6	0808	0807	16.5	0000	2305	1515 7/5	3091 -5/2	12z
									1518 4/1	3085 -4/1	00z
Fr 16	Low centre now over south coast with major trough holding over southern mainland	BKN - OVC with rain in morning. Clearing in afternoon allowed few TCU/CB buildups	20.1	0805	2309	20.7	0405	2807	1494 3/1	3057 5/1	12z
									1506 5/1	3072 -5/2	00z
Sa 17	Low moved out of base of trough but trough remains N-S over Vancouver. Cooler air advecting from west aloft. Drier nwly flo aloft but vort centres approaching over dirty ridge upstream and becoming enhanced when reaching coast	Fog reported overnight. SCT in morning with SCT-BKN TCU/CB buildups by early afternoon	21.5	1101	2207	21.9	2703	2308	1503 4/1	3069 -4/2	12z
									1536 5/1	3109 -3/3	00z

JULY	Synoptic/ Upper Pattern	Surface	YVR max (C)	YVR Wind 6 am PST (14z)	YVR Wind 2 pm PST (22z)	YXX max (C)	YXX Wind 6 am PST (14z)	YXX Wind 2 pm PST (22z)	850 hPa Height (m) T/T-Td (C)	700 hPa Height (m) T/T-Td (C)	Z hr 12Z = 0400 PST 00Z = 1600 PST
Su 18	Trough remains in place. Little change in upper pattern	Still unstable but sunnier. Few SCT - BKN TCU/CB	21.4	21.4	2508	23.7	0000	3006	1533 6/3	3106 -4/4	12z
									1545 6/3	3124 -2/4	00z
Mo 19	Short wave became enhanced over Wash (Washington) and gave rain to Puget Sound. Lower Fraser Valley (LFV) on northern fringe of system. Extensive mid-hi level moisture	SCT in YVR in morning while BKN in YXX (Abbotsford). Rain and thick cloud remained south of border but mid-hi cld increased over LFV. Some holes in cloud gave sunny patches. Test flight P306	21.1	0902	2107	21.8	0802	2306	1521 8/3	3097 -3/7	12z
									1512 7/1	3091 -3/5	00z
Tu 20	Low deepened over Wash and spread extensive cloud all levels over LFV. Upper trough still over Vancouver and more short waves advancing upstream	Bases at 700-3000 feet OVC over most of LFV with rain most areas. Embedded convective cloud	16.3	1106	1009	16.4	2105	1808	1490 5/1	3063 -4/1	12z
									1500 3/3	3069 -4/4	00z
We 21	Left with a thick ST layer behind a retreating system. Aleutian low holding. Split flow diverted part of wave over Charlottes where it caught a vort center and became major system. Southern portion of wave over Wash	OVC ST/SC (Stratus/ Stratocumulus) and rain all day	19.6	1009	1107	18.6	0000	0000	1484 3/4	3054 -4/5	12z
									1469 3/1	3042 -2/1	00z

JULY	Synoptic/ Upper Pattern	Surface	YVR max (C)	YVR Wind 6 am PST (14z)	YVR Wind 2 pm PST (22z)	YXX max (C)	YXX Wind 6 am PST (14z)	YXX Wind 2 pm PST (22z)	850 hPa Height (m) T/T-Td (C)	700 hPa Height (m) T/T-Td (C)	Z hr 12Z = 0400 PST 00Z = 1600 PST
Th 22	Main stream now pushing more swd into Wash. Ridging along 160 W now more apparent on water vapor satellite animation loop. Aleutian low shows weak signs of filling	Rain and cloudy with OVC ST/SC. ST marine layer over west coast Vancouver Island about 13000 ft thick. Too high for lidar so cancelled cloud physics flt. Cvctv (convective) cloud with holes in late evening ovr YVR (Vancouver)	18.5	1105	0907	18.7	0602	0603	1439 7/1 1472 5/1	3030 -2/1 3048 -1/7	12z 00z
Fr 23	Ridge building along 145-150W. LFV is still on north side of jet with troughing along coast. Ridge will form from central Pacific toward south coast over weekend	Am OVC but bases lifted to 6000-10000 ft and became SCT in valley in afternoon. Much convection about, especially over mtns. Patchy overrunning AC (mid cloud) from system to north. Surface winds weaker than expected in pm but good easterly push	20.4	0803	2409	21.0	2704	2707	1487 4/1 1533 4/1	3057 -2/3 3109 1/7	12z 00z
Sa 24	Ridge still building but flattened over eastern portions by short wave over interior. Models show ridge re-amplifying over west coast next 24 hours	Am OVC became sunny by 2 pm. TCU/CB over mtns. Some AC. Surface ridge offshore. Flight P307	20.6	1104	2408	20.9	2703	2308	1533 4/4 1536 6/4	3100 -3/7 3118 -1/3	12z 00z

JULY	Synoptic/ Upper Pattern	Surface	YVR max (C)	YVR Wind 6 am PST (14z)	YVR Wind 2 pm PST (22z)	YXX max (C)	YXX Wind 6 am PST (14z)	YXX Wind 2 pm PST (22z)	850 hPa Height (m) T/T-Td (C)	700 hPa Height (m) T/T-Td (C)	Z hr 12Z = 0400 PST 00Z = 1600 PST
Su 25	LFV on east side of upper ridge. Subsidence aloft. Patchy mid cloud	SCT by 7-9 am. Few CU/TCU over mtns. Sunny day. Good northwesterly winds over Richmond during the day	21.1	0000	2907	23.8	0000	2110	1539 6/2 1564 10/4	3115 -3/6 3155 1/6	12z 00z
Mo 26	Now under east side of ridge but high over Pacific is retrogressing as Aleutian low flattens ridge and moves over north coast. Short wave approaching over top of ridge	SCT and sunny skies. Light winds. Flight P308	23.0	1102	2406	24.5	0000	0000	1551 10/5 1561 10/4	3146 1/8 3158 3/8	12z 00z
Tu 27	Upper low over Alaska Panhandle moving slowly sewd but trough digging swwd and farther offshr than progged. Front over northern Vrisl (Vancouver Island) weakening. Mid-hi level cloud being sheared	YVR and YXX /SCT (high scattered) in am. YVR became 4000 SCT 8000 SCT /BKN by 1030 PDT am. YXX gradually became /BKN by early pm. Flight P309	22.7	1106	1004	22.5	0000	2508	1506 11/10 1481 8/1	3106 1/2 3072 1/4	12z 00z
We 28	Cold low offshore Vrisl moving slowly ssewd with southern mainland in PVA (positive vorticity advection) area southeast of low. Enhanced frontal band over south coast	50 -70 OVC in RW-F (light rainshowers and fog) in am. Cloud lifted somewhat in pm as latest band moved ewd. Airmass unstable with TCU about	18.8	1007	1413	17.7	0000	2603	1442 6/1 msg	2786 -1/6 msg	12z 00z

JULY	Synoptic/ Upper Pattern	Surface	YVR max (C)	YVR Wind 6 am PST (14z)	YVR Wind 2 pm PST (22z)	YXX max (C)	YXX Wind 6 am PST (14z)	YXX Wind 2 pm PST (22z)	850 hPa Height (m) T/T-Td (C)	700 hPa Height (m) T/T-Td (C)	Z hr 12Z = 0400 PST 00Z = 1600 PST
Th 29	Cold low now moving ene and dragging trough over southern mainland today. Airmass quite unstable with extensive TCU/CB cells. Bands of moisture continue to get enhanced by coastline	Latest moisture band over VRISL and Olympics but moving ne so best conditions to the south. 5000-7000 OVC with TCU/CB showers in am in YVR. SCT in YXX in am then RW in pm	19.5	0706	1609	18.5	2405	1811	1439 2/1 1484 3/1	2987 -7/3 3035 -8/2	12z 00z
Fr 30	Vort centre in trof kicked up major thunderstorm over YVR overnight. Trof moved east by am but much moisture lingering and airmass still unstbl. Next wave will reach south coast this evening. Models show drying trend over wk-end	Widespread ptchs moisture all levels. CU in low levels. Breaks in cloud allowed heating to spring more cvctv cld. Shorter break than expected between upper trof and next wave. 4000-7000 BKN in am with rapid TCU buildups. Flt cancelled due cld below 14000	20.1	2006	2006	19.7	0000	0000	1524 2/1 1570 6/1	3082 -5/5 3152 -2/1	12z 00z
Sa 31	Upr ridge built up faster than expected with good subsidence. Upstream system tracked more northward and dissipated as upper cloud broke away from rest of system. Low cloud offshore and to the north but subsidence dried much of cloud over lower mainland	Surface ridging and stabilizing airmass. SCT in am and became drier through the day. Flight P310	21.6	0703	2705	25.0	0303	2704	1591 7/1 msg ** 10/2	3170 -2/2 msg ** 3/10	12z 00z

AUG	Synoptic/ Upper Pattern	Surface	YVR max (C)	YVR Wind 6 am PST (14z)	YVR Wind 2 pm PST (22z)	YXX max (C)	YXX Wind 6 am PST (14z)	YXX Wind 2 pm PST (22z)	850 hPa Height (m) T/T-Td (C)	700 hPa Height (m) T/T-Td (C)	Z hr 12Z = 0400 PST 00Z = 1600 PST
Su 01	Under eastern edge of building ridge with trofing nwd from Calif. This will bring the warm temps but still need more subsidence aloft for true episode. Nwly flow aloft bringing cooler air than would like to see. Warming at 850 mb very slow	Clear skies. Surface gradients fairly strong from northwest. Flights P311 and P312b	23.1	0000	2912	27.0	0000	2206	msg ** 14/10 1615 11/4	msg ** 5/5 3231 6/7	12z 00z
Mo 02	Still under east side of ridge. Major trough from northeastern Canada is poking over Prairies and into BC. Looks like this may push through the ridge in 4-5 days. Still have good n/nwly flow over area	Clear skies. Surface gradients still nw and fairly strong. Thermal trough at surface from south giving outflow and high temps. Flight P313	23.7	3011	2912	32.3	0000	3106	1585 15/7 1570 17/10	3210 6/9 3197 6/8	12z 00z
Tu 03	Weak vorticity centre over lower mainland along trof line from VRISL swwd. Models show closed vort centre over us Wed then opens on Thursday with weaker flow aloft. Subsidence still evident on YZT and UIL tephis at 10000 ft but slight coolng at 850 mb	Airmass fairly dry so only few flat CU expected over ridges and eastern end of valley where heating strongest and topographic lifting will occur. 5000 SCT CU/CF in am. Flight P314a, P315b	26.0	3012	3112	33.5	0000	0000	1530 16/7 1527 19/12	3158 7/10 3164 7/10	12z 00z

AUG	Synoptic/ Upper Pattern	Surface	YVR max (C)	YVR Wind 6 am PST (14z)	YVR Wind 2 pm PST (22z)	YXX max (C)	YXX Wind 6 am PST (14z)	YXX Wind 2 pm PST (22z)	850 hPa Height (m) T/T-Td (C)	700 hPa Height (m) T/T-Td (C)	Z hr 12Z = 0400 PST 00Z = 1600 PST
We 04	A vort centre over us gave strong convection that built to afternoon CBs in the valley. The centre will move southeast tomorrow. Cooling aloft and loss of subsidence due to retrogressing ridge and approaching trough	Strong TCU/CB buildups in the afternoon especially in the eastern end of the valley. Rain reported in Burnaby and Sumas Ridge around 6 pm. Flight P316	28.9	3102	2907	33.9	0303	2607	1515 18/9 msg	3146 4/7 msg	12z 00z
Th 05	The vort centre has moved southeastward and a shortwave ridge is over us with a return to subsidence (YZT tephi). This to remain today and tomorrow then short wave trough over us late Friday	Clear skies, warm temperatures. Flight P317a, P318b	29.4	2101	1905	29.9	2303	2405	1545 17/12 1554 17/12	3170 5/9 3182 5/9	12z 00z
Fr 06	Shower activity heaviest near low center over YXS (Prince George) so may escape heavy cvctn over us this afternoon. Upr rdg bldg nwwd in Pacific and trof still pushing swwd ovr us. Will be in base on Sunday. Another trof bringing rain Monday	Westerlies pushed ST thru Juan de Fuca Strait and to YXX from east side Puget Sound. Fog at YXX 8 am - 1 pm. Also over Richmond, Ladner and other delta areas. Expect northwesterlies to kill northward motion of stratus tomorrow. Flight P319a, P320b	22.8	1208	1807	22.8	2707	2406	1524 14/11 1497 14/11	3146 7/10 3115 6/9	12z 00z

AUG	Synoptic/ Upper Pattern	Surface	YVR max (C)	YVR Wind 6 am PST (14z)	YVR Wind 2 pm PST (22z)	YXX max (C)	YXX Wind 6 am PST (14z)	YXX Wind 2 pm PST (22z)	850 hPa Height (m) T/T-Td (C)	700 hPa Height (m) T/T-Td (C)	Z hr 12Z = 0400 PST 00Z = 1600 PST
Sa 07	Upper short wave trough diverted eastward and missed us. Next trough in Alaska/Yukon will reach south coast tomorrow	Short wave caused bit of low-mid cld which started ovrnght. Onshore flow pushed marine stratus into JDF, along coast and into eastern end Fraser Valley, including YXX. Stratus lasted till about 1 pm. Airmass moist to about 1500 m on UIL tephi	22.2	0904	2107	22.6	2703	2204	1457 12/11 1448 12/9	3066 5/9 3060 5/9	12z 00z
Su 08	Retrogressing ridge forcing heights to fall and sharpening trof along 130W this pm. Baroclinic zone moving across VRISL this pm with clouds and showers expected ovr LFV late tonight/early Mon. Stratus from YVR to YXX and Puget Sound lingering	Front over north coast should slide to south coast by Monday am. Marine layer eroding this pm. Cooler temperatures and increasing POPS (Probability of Precipitation) through Tuesday	21.7	1006	1113	21.2	2602	2102	1442 8/4 1463 6/1	3039 4/9 3054 3/7	12z 00z
Mo 09	Long wave trof ne-sw over area with front crossing region north to south	Much low cloud behind front with weak gradients behind so should linger some time. Short wave ridge indicated on US models Tues but low cloud should remain	18.8	1106	1005	18.1	0000	0302	1469 5/1 1509 6/1	3048 -2/1 3088 -3/1	12z 00z

AUG	Synoptic/ Upper Pattern	Surface	YVR max (C)	YVR Wind 6 am PST (14z)	YVR Wind 2 pm PST (22z)	YXX max (C)	YXX Wind 6 am PST (14z)	YXX Wind 2 pm PST (22z)	850 hPa Height (m) T/T-Td (C)	700 hPa Height (m) T/T-Td (C)	Z hr 12Z = 0400 PST 00Z = 1600 PST
Tu 10	Still in base of trough with upper ridge building offshore. Drying associated then next wave will reach south coast Thursday. N/nwly flow but heights remain approx 570 so less convection than otherwise	Flight over SToff Estevan Pt at ~ 49N 130W. Top at ~2500' and a few hnd ft off the water. Front now passed but lo-mid cld left behind. Mnly sunny with few cvctv clds over ridges in pm. Slack gradient. Flight P321	20.5	0000	2706	22.5	0000	2408	1509 5/1 1533 6/2	3088 -2/3 3112 -1/8	12z 00z
We 11	Upr rdg ovr Pacific bulging sewd. Upr trof now ovr srn Interior. Upr ridge expected here in 24 hrs but will weaken. Short wave ridge kept cvctn down	Warm sunny day	21.6	0000	2906	24.5	0304	3004	1530 7/3 1545 8/6	3109 0/7 3106 3/9	12z 00z
Th 12	Short wave trof slowly approachng from Charlottes. LFV under back end of upr short wave ridge and ahead of short wave trof	Thick fog in am along coast and into YXX but downtown YVR clear. Slack gradient	22.2	1004	2210	22.2	2403	2307	1524 8/3	3112 3/8	12z

CLIMATE DATA										MONTH		JULY					YEAR		1993							06Z TO 06Z				
VANCOUVER												ABBOTSFORD									VICTORIA									
totals this year					pcp	530.3		sun	853.3			totals this year					pcp	795.9	sun	913.7	totals this year					pcp	394.1	sun	998.1	
day	max	min	pcp	sun	mnth	yr	rain	mnth	yr	mean	deg	day	max	min	pcp	sun	mnth	yr	mnth	yr	day	max	min	pcpn	sun	mnth	yr	mnth	yr
					total	total	days	total	total		days						total	total	total	total						total	total	total	total
1	19.0	11.7	0.2	2.2	0.2	530.6	1	2.2	855.5	15.4	3	1	20.0	11.7	nil	6.9	0.0	795.9	6.9	920.6	1	19.7	10.5	nil	6.5	0.0	394.1	6.5	1004.6
2	20.1	12.8	nil	7.4	0.2	530.6	1	9.6	862.9	16.5	2	2	22.3	9.5	nil	8.0	0.0	795.9	14.9	928.6	2	20.9	12.4	nil	11.4	0.0	394.1	17.9	1016.0
3	17.9	13.2	1.2	1.9	1.4	531.7	2	11.5	864.8	15.6	2	3	17.4	13.6	TR	0.7	0.0	795.9	15.6	929.3	3	20.7	14.5	nil	5.1	0.0	394.1	23.0	1021.1
4	20.6	12.8	nil	9.3	1.4	531.7	2	20.8	874.1	16.7	1	4	20.2	13.3	nil	4.3	0.0	795.9	19.9	933.6	4	20.5	10.2	nil	9.2	0.0	394.1	32.2	1030.3
5	19.3	10.2	nil	10.5	1.4	531.7	2	31.3	884.6	14.8	3	5	20.3	8.9	nil	8.6	0.0	795.9	28.5	942.2	5	20.4	8.7	nil	8.6	0.0	394.1	40.8	1038.9
6	19.8	10.2	nil	8.3	1.4	531.7	2	39.6	892.9	15.0	3	6	20.9	8.0	nil	6.3	0.0	795.9	34.8	948.5	6	19.3	8.7	TR	6.5	0.0	394.1	47.3	1045.4
7	19.8	11.2	nil	14.5	1.4	531.7	2	54.1	907.4	15.5	3	7	23.3	7.8	nil	13.8	0.0	795.9	48.6	962.3	7	21.3	9.0	nil	14.5	0.0	394.1	61.8	1059.9
8	20.0	12.8	nil	12.5	1.4	531.7	2	66.6	919.9	16.4	2	8	24.1	9.1	nil	14.1	0.0	795.9	62.7	976.4	8	21.7	8.7	nil	14.4	0.0	394.1	76.2	1074.3
9	20.4	11.1	nil	8.4	1.4	531.7	2	75.0	928.3	15.8	2	9	20.6	11.2	nil	4.7	0.0	795.9	67.4	981.1	9	19.3	8.2	nil	13.9	0.0	394.1	90.1	1088.2
10	19.8	13.1	nil	6.0	1.4	531.7	2	81.0	934.3	16.5	2	10	19.3	12.0	nil	4.7	0.0	795.9	72.1	985.8	10	22.0	8.7	nil	11.6	0.0	394.1	101.7	1099.8
11	18.2	13.0	2.4	4.1	3.8	534.1	3	85.1	938.4	15.6	2	11	19.0	13.1	nil	5.0	0.0	795.9	77.1	990.8	11	18.9	12.7	0.6	3.5	0.6	394.7	105.2	1103.3
12	18.5	13.4	0.8	4.7	4.6	534.9	4	89.8	943.1	16.0	2	12	17.5	11.7	2.8	0.4	2.8	798.7	77.5	991.2	12	18.7	12.6	TR	8.3	0.6	394.7	113.5	1111.6
13	20.4	14.0	TR	7.3	4.6	534.9	4	97.1	950.4	17.2	1	13	22.2	13.1	5.8	9.7	8.6	804.5	87.2	1000.9	13	21.1	12.6	nil	7.4	0.6	394.7	120.9	1119.0
14	20.0	14.0	0.8	6.2	5.4	535.7	5	103.3	956.6	17.0	1	14	20.2	13.5	7.1	3.6	15.7	811.6	90.8	1004.5	14	18.8	11.6	8.2	6.0	8.8	402.9	126.9	1125.0
15	16.6	12.5	4.0	0.3	9.4	539.7	6	103.6	956.9	14.6	3	15	16.5	10.5	TR	0.2	15.7	811.6	91.0	1004.7	15	18.4	10.4	TR	0.4	8.8	402.9	127.3	1125.4
16	20.1	13.1	0.6	7.3	10.0	540.3	7	110.9	964.2	16.6	1	16	20.7	13.3	0.6	6.3	16.3	812.2	97.3	1011.0	16	19.5	11.4	nil	9.0	8.8	402.9	136.3	1134.4
17	21.5	12.6	nil	11.0	10.0	540.3	7	121.9	975.2	17.1	1	17	21.9	9.9	tr	7.3	16.3	812.2	104.6	1018.3	17	21.8	11.1	nil	11.2	8.8	402.9	147.5	1145.6
18	21.4	14.7	nil	10.1	10.0	540.3	7	132.0	985.3	18.1	0	18	23.7	13.4	nil	12.0	16.3	812.2	116.6	1030.3	18	21.4	9.3	nil	14.0	8.8	402.9	161.5	1159.6
19	21.1	13.1	nil	4.9	10.0	540.3	7	136.9	990.2	17.1	1	19	21.8	10.5	0.2	7.7	16.6	812.4	124.3	1038.0	19	20.2	11.2	nil	4.3	8.8	402.9	165.8	1163.9
20	16.3	13.6	1.1	0.0	11.1	541.4	8	136.9	990.2	15.0	3	20	16.4	13.2	12.8	0.0	29.3	825.2	124.3	1038.0	20	20.1	13.2	60.0	5.3	68.8	452.9	171.1	1169.2
21	19.6	13.1	nil	2.5	11.1	541.4	8	139.4	992.7	16.4	2	21	18.6	13.0	TR	2.3	29.3	825.2	126.6	1040.3	21	18.0	13.4	nil	6.5	68.8	452.9	177.6	1175.7
22	18.5	14.0	2.2	0.3	13.3	543.6	9	139.7	993.0	16.3	2	22	18.7	12.9	2.0	0.4	31.3	827.2	127.0	1040.7	22	18.8	12.7	1.4	3.1	60.2	454.3	180.7	1178.8
23	20.4	12.8	tr	3.2	13.3	543.6	9	142.9	996.2	16.6	1	23	21.0	13.7	TR	6.8	31.3	827.2	135.8	1049.5	23	19.2	10.3	nil	1.0	60.2	454.3	181.7	1179.8
24	20.6	13.3	nil	6.2	13.3	543.6	9	149.1	1002.4	17.0	1	24	20.9	13.7	nil	5.4	31.3	827.2	141.2	1054.9	24	20.1	12.2	TR	9.0	60.2	454.3	190.7	1188.8
25	21.1	12.0	nil	13.9	13.3	543.6	9	163.0	1016.3	16.6	1	25	23.8	11.3	nil	12.8	31.3	827.2	154.0	1067.7	25	21.6	10.5	nil	13.6	60.2	454.3	204.3	1202.4
26	23.0	12.3	nil	13.5	13.3	543.6	9	176.5	1029.8	17.7	0	26	24.5	10.7	nil	13.7	31.3	827.2	167.7	1081.4	26	20.1	8.7	nil	13.4	60.2	454.3	217.7	1215.8
27	22.7	14.2	0.4	5.0	13.7	544.0	10	181.5	1034.8	18.5	0	27	22.5	11.5	nil	6.8	31.3	827.2	174.5	1088.2	27	17.3	9.0	nil	5.1	60.2	454.3	222.8	1220.9
28	18.8	14.6	14.2	0.0	27.9	558.2	11	181.5	1034.8	16.7	1	28	17.7	15.2	11.6	0.0	42.9	838.8	174.5	1088.2	28	19.1	11.8	6.2	2.0	66.4	460.6	224.8	1222.9
29	19.5	12.4	6.4	2.1	34.3	564.6	12	183.6	1036.9	16.0	2	29	18.5	10.5	3.4	3.0	46.3	842.2	177.5	1091.2	29	18.4	11.8	1.2	3.3	67.6	461.7	228.1	1226.2
30	20.1	11.6	tr	4.3	34.3	564.6	12	187.9	1041.2	15.9	2	30	19.7	11.7	0.6	3.6	46.9	842.8	181.1	1094.8	30	18.8	11.2	0.0	3.1	67.6	461.7	231.2	1229.3
31	21.6	15.1	nil	13.0	34.3	564.6	12	200.9	1054.2	18.4	0	31	25.0	13.8	nil	12.3	46.9	842.8	193.4	1107.1	31	23.1	13.3	nil	13.6	67.6	461.7	244.8	1242.9
YVR normal pcp					36.1		year of record		Avg Mx		19.9	YXX normal pcp					41.2		year of record		YYJ normal pcp					18.1		year of record	
RECORD HIGH PCP					81.3		1972		Avg Mn		12.9	RECORD HIGH PCP									RECORD HIGH PCP								
RECORD LOW PCP					TR		1951	1985	Mean		16.4	RECORD LOW PCP									RECORD LOW PCP								
normal sun					307.1				Sun		200.9						290.6				normal sun					329			
RECORD HIGH SUN					388.1		198.5					RECORD HIGH SUN									RECORD HIGH SUN								
RECORD LOW SUN					210.2		198.2					RECORD LOW SUN									RECORD LOW SUN								
record high temp					31.7				Max	23.0	/26	record high temp					37.8		1958		record high temp					36.1			
record low temp					6.7				Min	10.2	/5	record low temp					2.2		1945		record low temp					4.1			

CLIMATE DATA											MONTH	AUGUST					YEAR	93									O6Z TO O6Z			
VANCOUVER												ABBOTSFORD											VICTORIA								
totals this year					pcp	564.6		sun	1054.2			totals this year					pcp	842.6	sun	1107.1		totals this year					pcp	461.7	sun	1242.9	
day	max	min	pcp	sun	mnth total	yr total	rain days	mnth total	yr total	mean	deg days	day	max	min	pcp	sun	mnth total	yr. total	mnth. total	yr. total	day	max	min	pcp	sun	mnth total	yr total	mnth total	yr total	
1	23.1	13.5	NIL	14.4	0.0	564.6	0	14.4	1068.6	18.3	0	1	27.0	11.3	NIL	14.3	0.0	842.8	14.3	1121.4	1	25.3	11.5	NIL	14.4	0.0	461.7	14.4	1257.3	
2	23.7	15.5	NIL	14.2	0.0	564.6	0	28.6	1082.8	19.6	0	2	32.3	13.3	NIL	14.4	0.0	842.8	28.7	1135.8	2	30.4	13.1	NIL	14.3	0.0	461.7	28.7	1271.6	
3	26.0	17.0	NIL	13.4	0.0	564.6	0	42.0	1096.2	21.5	0	3	33.5	14.6	NIL	11.0	0.0	842.8	39.7	1146.8	3	31.5	13.8	NIL	13.9	0.0	461.7	42.6	1285.5	
4	28.9	16.6	NIL	13.7	0.0	564.6	0	55.7	1109.9	22.6	0	4	33.9	16.4	NIL	12.1	0.0	842.8	51.8	1158.9	4	31.6	13.8	NIL	13.1	0.0	461.7	55.7	1298.6	
5	29.4	17.2	NIL	13.9	0.0	564.6	0	69.6	1123.8	23.3	0	5	29.9	16.3	NIL	10.4	0.0	842.8	62.2	1169.3	5	24.7	14.1	NIL	13.9	0.0	461.7	69.6	1312.5	
6	22.8	14.7	NIL	13.7	0.0	564.6	0	83.3	1137.5	18.8	0	6	22.8	14.0	NIL	10.2	0.0	842.8	72.4	1179.5	6	20.6	10.6	NIL	13.6	0.0	461.7	83.2	1326.1	
7	22.2	13.5	NIL	7.7	0.0	564.6	0	91.0	1145.2	17.9	0	7	22.6	13.5	NIL	4.6	0.0	842.8	77	1184.1	7	20.5	9.2	NIL	9.5	0.0	461.7	92.7	1335.6	
8	21.7	16.6	NIL	3.4	0.0	564.6	0	94.4	1148.6	19.2	0	8	21.2	15.6	NIL	0.5	0.0	842.8	77.5	1184.6	8	19.2	10.0	NIL	0.3	0.0	461.7	93.0	1335.9	
9	16.8	15.3	9.4	0.0	9.4	574.0	1	94.4	1148.6	17.1	1	9	16.1	14.5	7.8	0.0	7.8	850.6	77.5	1184.6	9	17.2	11.8	6.4	0.0	6.4	467.1	93.0	1335.9	
10	20.5	14.8	tr	6.8	9.4	574.0	1	101.2	1155.4	17.7	0	10	22.5	14.2	0.6	7.0	8.4	851.2	84.5	1191.6	10	20.5	12.6	nil	4.8	5.4	467.1	97.8	1340.7	
11	21.6	12.3	nil	13.4	9.4	574.0	1	114.6	1168.8	17.0	1	11	24.5	11.3	nil	13.9	8.4	851.2	98.4	1205.5	11	23.1	11.8	nil	11.4	5.4	467.1	109.2	1352.1	
12	22.2	12.9	nil	9.1	9.4	574.0	1	123.7	1177.9	17.6	0	12	22.2	10.3	nil	10.1	8.4	851.2	108.5	1215.6	12	21.2	11.4	nil	13.0	5.4	467.1	122.2	1365.1	
13	19.3	13.4	nil	0.5	9.4	574.0	1	124.2	1178.4	16.4	2	13	19.6	10.6	nil	1.0	8.4	851.2	109.5	1216.6	13	20.1	11.7	nil	5.6	5.4	467.1	127.8	1370.7	
14	18.2	12.9	1.8	0.5	11.2	575.8	2	124.7	1178.9	15.6	2	14	17.6	13.5	1.6	0.0	10.0	852.8	109.5	1216.6	14	18.2	12.8	0.4	1.2	5.8	467.5	129.0	1371.9	
15	20.6	14.6	0.4	1.6	11.6	576.2	3	126.3	1180.5	17.6	0	15	17.1	14.2	6.2	0.0	16.2	859.0	109.5	1216.6	15	19.6	12.6	tr	2.4	5.8	467.5	131.4	1374.3	
16	18.0	14.5	1.2	0.1	12.8	577.4	4	126.4	1180.6	16.3	2	16	16.2	14.9	2.2	0.0	18.4	861.2	109.5	1216.6	16	19.7	11.9	tr	1.8	5.8	467.5	133.2	1376.1	
17	22.0	14.5	NIL	11.3	12.8	577.4	4	137.7	1191.9	18.3	0	17	22.2	13.8	0.0	3.8	18.4	861.2	113.3	1220.4	17	20.8	11.3	0.0	6.4	5.8	467.5	139.6	1382.5	
18	23.1	12.8	NIL	12.0	12.8	577.4	4	149.7	1203.9	18.0	0	18	25.9	10.8	0.0	13.3	18.4	861.2	126.6	1233.7	18	24.7	10.8	0.0	12.5	5.8	467.5	152.1	1395.0	
19	23.3	14.5	NIL	13.0	12.8	577.4	4	162.7	1216.9	18.9	0	19	28.7	12.8	0.0	13.1	18.4	861.2	139.7	1246.8	-19	25.8	11.6	-0.0	13.0	-5.8	-467.5	165.1	1408.0	
20	24.3	14.0	NIL	12.1	12.8	577.4	4	174.8	1229.0	19.2	0	20	24.2	12.6	0.0	12.6	18.4	861.2	152.3	1259.4	20	21.2	11.3	0.0	12.4	5.8	467.5	177.5	1420.4	
21	17.6	13.6	0.2	0.0	13.0	577.6	5	174.8	1229.0	15.6	2	21	18.9	13.9	0.2	0.2	18.6	861.4	152.5	1259.6	21	16.9	13.0	0.4	0.3	6.2	467.9	177.8	1420.7	
22	23.0	14.6	6.8	0.7	18.8	583.4	6	175.5	1229.7	18.8	0	22	24.0	15.2	3.2	2.2	21.8	864.6	154.7	1261.8	22	20.1	12.4	6.6	1.9	12.8	474.5	179.7	1422.6	
23	19.6	13.9	0.2	6.4	19.0	583.6	7	183.9	1238.1	16.8	1	23	20.6	11.6	3.1	7.6	24.9	867.7	162.3	1269.4	23	20.3	11.2	tr	12.6	12.8	474.5	192.3	1435.2	
24	18.1	13.2	NIL	7.5	19.0	583.6	7	191.4	1245.6	15.7	2	24	18.5	11.2	0.0	5.8	24.9	867.7	168.1	1275.2	24	18.2	10.6	tr	5.6	12.8	474.5	198.1	1441.0	
25	18.6	9.3	NIL	11.6	19.0	583.6	7	203.0	1257.2	14.0	4	25	20.4	6.9	0.0	9.8	24.9	867.7	177.9	1285.0	25	18.7	6.7	0.0	12.6	12.8	474.5	210.9	1453.8	
26	19.7	9.5	NIL	6.8	19.0	583.6	7	209.8	1264.0	14.6	3	26	22.2	6.2	0.0		24.9	867.7	177.9	1285.0	26	19.8	7.6	0.0	9.8	12.8	474.5	220.7	1463.6	
27	19.9	12.8	nil	8.7	19.0	583.6	7	218.5	1272.7	16.4	2	27	21.5	11.1	tr	10.3	24.9	867.7	188.2	1295.3	27	20.5	11.1	nil	9.9	12.8	474.5	230.6	1473.5	
28	19.6	9.7	nil	12.0	19.0	583.6	7	230.5	1284.7	14.7	3	28	22.1	9.1	tr	10.6	24.9	867.7	198.8	1305.9	28	21.4	8.5	nil	12.7	12.8	474.5	243.3	1486.2	
29	20.7	10.8	nil	12.5	19.0	583.6	7	243.0	1297.2	15.8	2	29	25.5	9.0	nil	13.0	24.9	867.7	211.8	1318.9	29	22.7	8.0	nil	12.9	12.8	474.5	256.2	1499.1	
30	21.1	10.9	nil	12.6	19.0	583.6	7	255.6	1310.0	16.0	2	30	27.1	8.2	nil	12.4	24.9	867.7	224.2	1331.3	30	25.0	8.2	nil	12.9	12.8	474.5	269.1	1512.0	
31	19.9	10.9	nil	9.4	19.0	583.6	7	265.2	1319.4	15.4	3	31	25.4	9.1	nil	9.7	24.9	867.7	233.9	1341.0	31	22.4	8.9	nil	9.2	12.8	474.5	278.3	1521.2	
YVR normal pcp						38.1	year of record					YXX normal pcp						53.1	year of record			YYJ normal pcp						23.7	year of record		
RECORD HIGH PCP						170	'91					RECORD HIGH PCP						187.2	'91			RECORD HIGH PCP						96.5	'75		
RECORD LOW PCP						TR	'86					RECORD LOW PCP						0.8	'86			RECORD LOW PCP						NIL	'86		
normal sun						264.9						normal sun						254.5				normal sun						269.3			
RECORD HIGH SUN						349.7	'87					RECORD HIGH SUN						313.2	'86			RECORD HIGH SUN						348.2	'87		
RECORD LOW SUN						142.7	'76					RECORD LOW SUN						123.5	'76			RECORD LOW SUN						148.1	'76		
record high temp						33.3	'90					record high temp						36.3	'77/80			record high temp						34.4	'60		
record low temp						6.1	'37					record low temp						3.3	'47/73			record low temp						4.4	'73		